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AFFDL-TR-71-5
PART I, VOL II

AD 892535

SUBSONIC UNSTEADY AERODYNAMICS FOR GENERAL CONFIGURATIONS

PART I, VOL II—COMPUTER PROGRAM H7WC

J. P. GIESING
T. P. KALMAN
W. P. RODDEN

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TECHNICAL REPORT AFFDL-TR-71-5, PART I, VOL II

NOVEMBER 1971

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FOREWORD

This report was prepared by the Douglas Aircraft Company, Long Beach, California, for the Aerospace Dynamics Branch, Vehicle Dynamics Division, Air Force Flight Dynamics Laboratory, Wright-Patterson Air Force Base, Ohio, under Contract F33615-70-C-1167. This research was conducted under Project 1370, "Dynamic Problems in Military Flight Vehicles," and Task 137003, "Prevention of Dynamic Aeroelastic Instabilities in Advanced Military Aircraft." Mr. S. J. Pollock of the Aerospace Dynamics Branch was Task Engineer.

This report consists of two parts with two volumes for each part. This volume, Volume II of Part I is the Computer Program H7WC. Volume I of Part I consists of the method of direct application of nonplanar lifting surface elements. Volume I of Part II, contains a method which uses an image system and an axial singularity system to account for the effects of the bodies and Volume II of Part II is the Computer Program N5KA.

The work reported herein was conducted during the period of December 1969 to September 1970.

The Principal Investigator was Joseph P. Giesing. Mrs. Terez P. Kalman was responsible for implementing the method on the computer. Donald H. Larson aided in this implementation and acted as consultant for computer problems. Dr. William P. Rodden, a McDonnell Douglas Company Consultant, contributed many valuable ideas to the project. Others have made significant contributions to this project including Messrs. D. S. Warren and W. E. Henry.

The report was submitted by the authors in November 1970 for publication as an AFFDL Technical Report.

This technical report has been reviewed and is approved.

Walter J. Mykytow
WALTER J. MYKYTOW
Asst. for Research & Technology
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ABSTRACT

Two methods of accounting for body-lifting surface interference in unsteady flow are considered. The first method is described in Part I of this report, while the second will be described in Part II to follow.

The first method is a direct application of nonplanar lifting surface elements to both the lifting surfaces and the body surfaces. The body is treated as an annular wing. This type of idealization must be used with an axial doublet introduced to account for body incidence effects. The undesirable effects of the annular wing representation are then reduced.

The second approach, to be described in Part II, uses an image system and an axial singularity system to account for the effects of the bodies.

This volume contains the computer program and contains the FORTRAN listing. Volume I contains the development of the theory, correlation of theory with experimental data, and the parametric study.

CONTENTS

CONTENTS (CONT'D)

NOMENCLATURE

A	Reference total area
$\lfloor A \rfloor$	Matrix of box areas
a_{inm}	Polynomial mode coefficients for mode i
AIC	Matrix of influence coefficients relating generalized forces to generalized deflections for submodes
c	Chord length
$\bar{c}$	Reference chord length
C_m	Pitching moment coefficient $\left(\frac{\text{moment}}{q\ A\bar{c}}\right)$, (+ nose up)
C_n	Yawing moment coefficient $\left(\frac{\text{moment}}{q\ A\ s}\right)$ (+ nose right)
C_l	Rolling moment coefficient $\left(\frac{\text{moment}}{q\ \ As}\right)$ (+ clockwise)
C_Y	Force coefficient in y-direction $\left(\frac{\text{Force}}{q\ \ A}\right)$ (+ out right wing)
C_Z	Force coefficient in z-direction $\left(\frac{\text{Force}}{q\ \ A}\right)$ (+ vertically up)
c_m	Local moment coefficient $\left(\frac{\text{moment}}{q\ c^2}\right)$
c_n	Local normal force coefficient $\left(\frac{\text{normal force}}{qc}\right)$
e	Strip semi-width
f	Normalized deflection normal to surface (h/s)
h	Deflection normal to surface
K	Kernel
k_r	Reduced frequency, $\omega\bar{c}/2U_\infty$
L	Lift
M	Mach number;also moment
Q_{ij}	Generalized force
q	Dynamic pressure
$\bar{q}$	Generalized coordinates
R_o	Body radius
r	$\sqrt{(y-\eta)^2 + (z-\zeta)^2}$

s	Semi-span
U_∞	Free-stream velocity
W	Unnormalized normalwash
w	W/U_∞
wr	$w - w_b$
x, y, z	Coordinates of receving points
$\bar{x}, \bar{y}, \bar{z}$	Element coordinates of receiving points
x_o	Gust reference axis
α	Angle of attack; also a function defined by Equation 2.1-15
β	$\sqrt{1 - M^2}$; also control surface deflection
Γ_g	Gust dihedral angle. ($\Gamma_g = 0$ if gust velocity is vertical)
γ	Dihedral angle
ΔC_p	Lifting pressure coefficient $\dfrac{P_{lower} - P_{upper}}{q}$
δ	Symmetry index (right and left symmetry); also tab deflection
ϵ	Ground effect index
λ	Wave length
ξ, η, ζ	Coordinates of sending points
$\bar{\xi}, \bar{\eta}, \bar{\zeta}$	Coordinates of sending points in element coordinates
ρ_2	Density at sea level
σ	Lateral coordinate in the plane of the surface
ω	Frequency

Subscripts and Superscripts

a	body axis
B	body
c	center
f	Body or fuselage
g	gust

i	Deflection mode
j	Pressure mode
L. E.	Leading edge
LL	Lower left
LR	Lower right
R	Axis about which moments are taken
r	Receiving
s	Sending
UL	Upper left
UR	Upper right
y	y-direction
z	z-direction
1/4	One quarter chord point of a lifting surface box
3/4	Three quarters chord point of a lifting surface box

1.0 INTRODUCTION

Computer program H7WC is the result of modifying and extending program H7WB. Program H7WB generates aerodynamic influence coefficients and gust loads for nonplanar surfaces. The modifications to this program include:

(1) An extension to accept polynomial mode input. (Subroutine GENQ)

(2) The addition of a capability to determine generalized forces. (Subroutine GENF)

(3) The addition of a capability to account for body angle of attack and camber effects using an axial pressure doublet system. (Subroutines AUGW, TKER)

(4) A refined version of the Doublet-Lattice Method to properly handle problems involving small vertical gaps between wing and tail surfaces. (Subroutine IDF2)

(5) The addition of the Quasi-Inverse for solving large numbers of modes or submodes, and for solving future modes with a minimum of computing effort. (Subroutines QUAS, FUTSOL, CXSS)

Program H7WC can handle almost any type of configuration if it is idealized properly. The axial pressure doublets give the proper slender body flow field for an axially symmetric body of any shape. The body/lifting-surface interference is taken care of using lifting surface panels on the body surface. The interference elements must lie on an idealized body of constant cross sectional shape. The rules that apply to the placement of a grid of boxes on the aircraft lifting surfaces also apply to the interference surfaces on the bodies. These rules are:

(1) Boxes (trapezoidal elements) are arranged in strips parallel to the free-stream. The aspect ratio of such boxes should not be large. For the unsteady case, an aspect ratio of order unity or less is preferred.

(2) Surface intersections, surface edges, fold lines, and hinge lines should lie on box boundaries.

(3) For wing-tail type configurations the strip boundaries on the tail must be aligned with those on the wing. Strips should be concentrated near the wing tips, near control surface edges and in any region where the span loading changes rapidly.

(4) The box length must be small compared to the basic wave length.

$$\frac{\Delta x}{\lambda} \leq 0.04$$

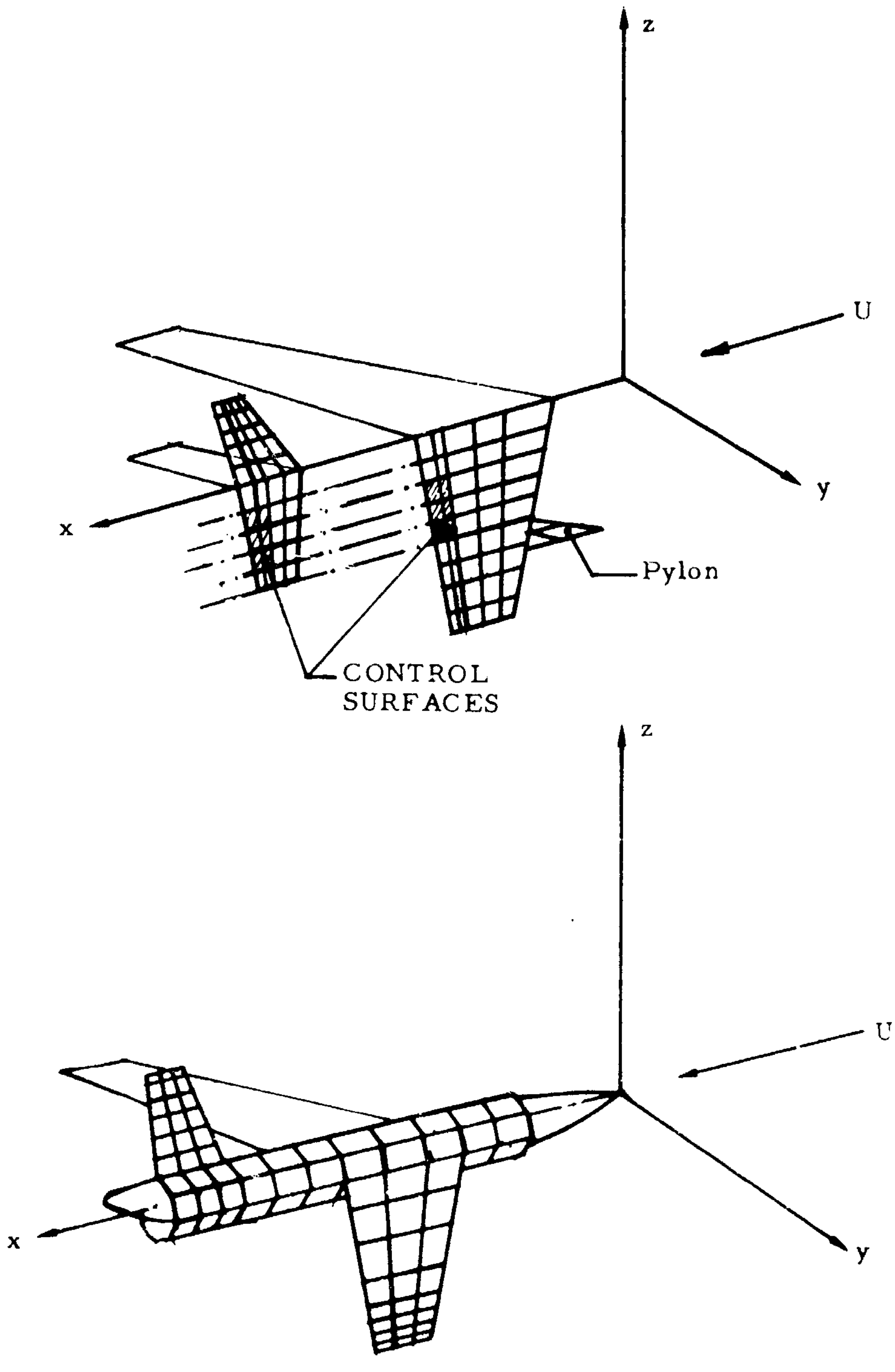
Boxes should also be concentrated near control surface hinge-lines and in all regions where the upwash boundary conditions are discontinuous.

(5) The body cross-sectional shape on which interference lifting surfaces are placed must be constant in the x-direction even for wing-tail problems. (This does not apply to the slender body solution for which the radius distribution is used.)

Sketch 1.1-1 gives examples of these 5 rules.

Because of the numerical techniques involved, the two-dimensional radial distance, $\sqrt{(y-\eta_e)^2 + (z-\zeta_e)^2}$, between a control point, y, z, (3/4-chord point of a box) and a box edge, η_e, ζ_e, may never approach zero. It does not matter whether the control point is on the same or on a different surface or whether it is up-or downstream from the box in question. This is easily understood for a control point in the wake of the box since the control point may not approach the bound leg of the horseshoe vortex. However, it is also true upstream due to the approach taken for the unsteady effects. (If $k_r = 0$ the upstream effect at $\sqrt{(y-\eta)^2 + (z-\zeta)^2} \rightarrow 0$ vanishes).

Wing-body-tail problems must be handled using only one interference cross-section. That is, one constant cross-sectional shape must be used both near the wing and near the tail. If this rule is not followed the wakes of the lifting surface element lying on the cross-section near the wing may impinge on the tail surface.



Sketch 1.1-1

When a body mode is input it must be input both to the axial elements and to the interference body panels. It must be remembered, however, that the body is in motion either in the z-or y-directions while the lifting surfaces on the body are in motion normal to themselves. Thus the mode input for a particular body interference panel must be multiplied by $\cos\gamma$ for (+) z-motion and $-\sin\gamma$ for (+) y-motion where γ is the dihedral angle of the panel.

The following list gives the program limits.

1. The maximum number of unknowns, i. e., the aerodynamic boxes on the lifting surfaces plus the number of body elements, is 400.

2. The maximum number of aerodynamic degrees of freedom, in case of AIC calculations, is 130.

3. The maximum number of degrees of freedom per strip in case of AIC calculations is restricted to 4.*

4. The maximum number of modal right-hand sides is 40 per case.

5. The maximum number of aerodynamic boxes per spanwise division (strip) is 30.

6. The maximum number of spanwise divisions (strips) is 50.

7. The maximum number of bodies is 20.

Program H7WC was used successfully on the following computers: GE635, IBM 7094 and IBM 360/65. Core requirement for the program on the various computers is as follows:

GE635	IBM 7094	IBM 360/65	CDC 6600
28K words	32K words	126K bytes	100K bytes

If greater core capacity is available it is desirable to use it up to 260K bytes. The CDC version is slightly modified in dimensions.

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* This restriction comes from operational requirements on the IBM 7094. The number of degrees of freedom can easily be increased to the 7 discussed in Appendix D in Part I, Vol I by increasing the dimension 4 to 7 in subroutines AIC, AERØ, and FINAL.

2.0 COMPUTER PROGRAM H7WC

2.1 Input Procedure

2.1.1 Input Sheets

The input sheets for program H7WC are shown on the next three pages. The first three cards represent general case data that is input once per case. The next four* cards (4, 5, 6, 7) represent panel data that is repeated per panel. The panel data must be input in a certain order. The panel data for all "regular" lifting surfaces, (wing, tail, etc.) are input first. The panel data for all interference lifting surfaces (used for the bodies) is input last.

If a body can oscillate in both the z- and y-directions (nacelle) then it must be replaced by two bodies: one that moves in the z-direction and one that moves in the y-direction. The subsequent three** cards (8, 9. 10) are body data necessary for the slender body analysis. This data is repeated per body. Card 11 is used for miscellaneous modal and AIC data and must be completed in either case. Card 12 is used when a gust is desired. Card 13 indicates a series of cards that are used to identify lifting surface boxes with strips. Card 14 indicates one or more cards that identify the degrees of freedom to be used for each panel. This card is necessary only if AIC's are desired.

Cards 15 and 16 are used to identify axes for the AIC degrees of freedom. Card 17 is used for modal control data. Card 18 is used to input control data for panel modes, while card 19 represents a series of cards, repeated as necessary, to indicate polynomial mode coefficients for panels. Cards 20 and 21 are similar to cards 18, 19 except the modes pertain to the z and y modes of the bodies.

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* There may be more than four cards depending on the number necessary to present all θ_i and τ_i values.

** There may be more than three cards depending on the number necessary to present F and RAD.

ENGINEER ______ PHONE ______ DATE ______

PUNCH IN ALL CARDS

CASE (63 64 65 66 67 68)

PROGRAM NO. (73 74 75 76) H 7 W C

Cols 1–10	Cols 11–20	Cols 21–30	Cols 31–40	Cols 41–50	Cols 51–60	SEQ. NO. (77–80)
		HEADER				01
M	A	$\bar{c}$	s	c NP NB NRF	NCØRE	02
		KR_i ,	i = 1, NRF			03
X1	X2	X3	X4	Y1	Y2	04
Z1	Z2	NS NC	CØEF			05
		θ_i ,	i = 1, NC			06
		τ_j ,	j = 1, NS			07
Zc	Yc	NF NZ Y	CØEFF	MK1 MK2		08
		F_k ,	k = 1, NF			09
		RAD_k ,	k = 1, NF			10

REPEAT PER PANEL (cards 04–07)

REPEAT PER BODY (cards 08–10)

DIRECTIONS FOR KEYPUNCH DO NOT PUNCH BLANK COLUMNS NO UNDERPUNCHES IN SIGN FIELDS.

ENGINEER ______________ PHONE ______________ DATE ______________

PUNCH IN ALL CARDS   CASE (63 64 65 66 67 68) [ ][ ][ ][ ][ ][ ]   PROGRAM NO. (73 74 75 76) H 7 W C

Cols 1–10 (±)	Cols 11–20 (±)	Cols 21–30 (±)	Cols 31–40 (±)	Cols 41–50 (±)	Cols 51–60 (±)	SEQ NO. (77–80)	
NSTRIP NB1 NB2	NPR1 NPR2 NPR3	JØBNØ	JØBNØ2	NCUST JSP NPC	NSV NBV NY	11	
CZRØ	XZRØ	VEL	WG			12	
LIM1 LIM2 LIM3	. . .	LIM	j = 1, NSTRIP			13	
[illegible]	. . .	IS	k = 1, NP			14	
		XHI				15	REPEAT PER PANEL
		XHØ				16	
NM NT N5 N6 N7	NTPI	NTPM	MP MB			17	
NR NQ NA N8	NR NQ NA N8	. . .	i = 1, (NM)	(NP)		18	PANEL MODES
N M	ARQ		i = 1, MP			19	
NR NQ NA N8			i = 1, (NM) (NB)			20	BODY MODES
N M	ARQ		i = 1, MB			21	

DIRECTIONS FOR KEYPUNCH   DO NOT PUNCH BLANK COLUMNS ______   NO UNDERPUNCHES IN SIGN FIELDS.

ENGINEER ______ PHONE ______ DATE ______

PUNCH IN ALL CARDS   CASE (63 64 65 66 67 68)   PROGRAM NO. (73 74 75 76) H 7 W2 C

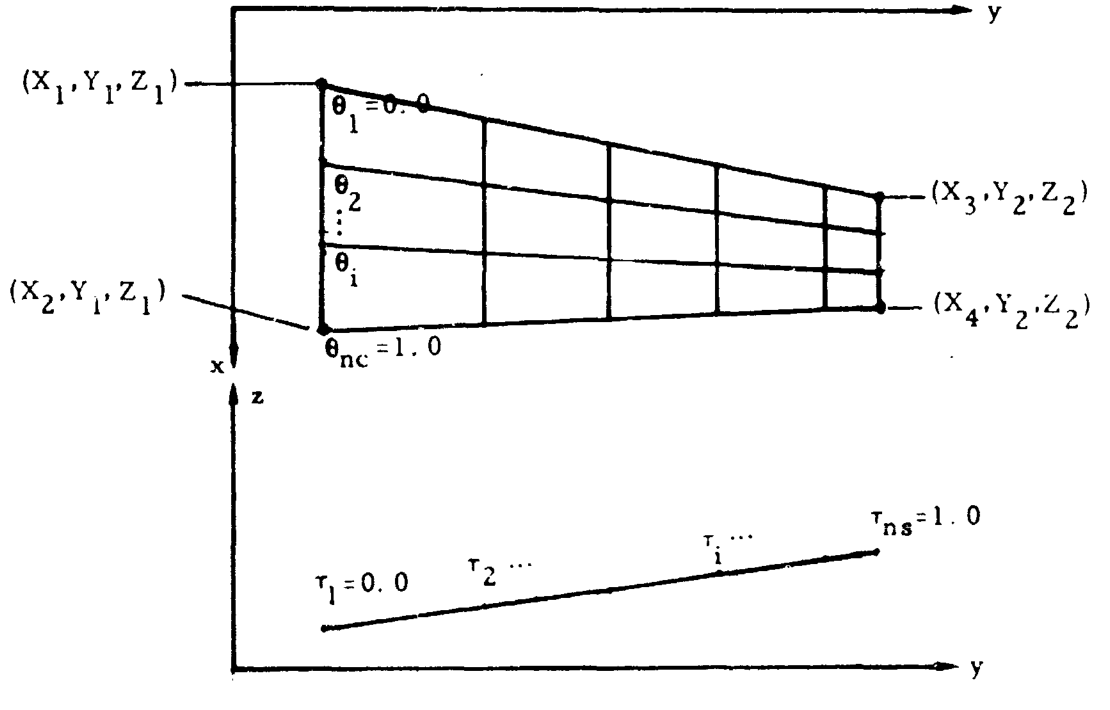
Cols 1–10	Cols 11–20	Cols 21–30	Cols 31–40	Cols 41–50	Cols 51–60	SEQ. NO. (77–80)
NBØX						22
		B_i,	i = 1, NBØX			23
		H_i,	i = 1, NBØX			24
		$DH1_i$,	i = 1, NBØX			25
NBEL						26
		B_i,	i = 1, NBEL			27
		H_i,	i = 1, NBEL			28
		$DH1_i$,	i = 1, NBEL			29
		$DH2_i$,	i = 1, NBEL			30

DIRECTIONS FOR KEYPUNCH   DO NOT PUNCH BLANK COLUMNS ______   NO UNDERPUNCHES IN SIGN FIELDS.

2. 1. 2 Description of Input Data

Item No.	Description
1	The header card is used to describe the current run being made. Any alphanumeric information can be used, placed in cc 1-60. The first 12 card columns should contain the tape title for the AIC's, in the case when AIC's are generated and are to be saved on master tape for later use.
2	M, FMACH — Mach number, usual definition.
3	A, ACAP — Reference area; usually total area of wing.
4	$\bar{c}$, REFCHD — Reference chord, usually average chord of wing
5	s, REFSPN — Reference semispan.
6	δ, NDELT — Symmetry flag (δ = 1 sym., δ = -1, antisym. δ = 0, no sym.).
7	NP, NOPAN — Total number of panels on all lifting surfaces.
8	NB — Total number of bodies.
9	NRF — Number of reduced frequencies for which the analysis has to be performed (repeated) - recommended maximum is 6 per case.
10	NCORE — Size of total solution, i.e., NCORE = N x M where N is the total number of elements or unknowns (including z and y fuselage elements) and M is the number of modes or the order of the AIC matrix if obtained.
11	NI — If "1", program assumes that case has been run previously and that a quasi-inverse exists on a tape (identified by NTPI) and only new modes are being run. If "0", program runs a new case.

Item No.	Description
12	N2 – If "0", polynomial modes are to be input. If "1" AIC's are to be calculated.
13	N3 – Data flag. If "1", matrix is printed; if "0", it is not printed.
14	N4 – Detail print flag for slender body solution; 1 to print, 0 otherwise.
15	KR – Array of reduced frequency, $KR = \frac{\omega \bar{c}}{2\,U_\infty}$.
16, 17, 18 19, 20, 21 22, 23	X1 X2 X3 X4 Y1 Y2 Z1 Z2 – Panel edge coordinates. X1, Y1, Z1 (Inboard leading edge) X2, Y1, Z1 (Inboard trailing edge) X3, Y2, Z2 (Outboard leading edge) X4, Y2, Z2 (Outboard trailing edge)
24	NS – Number of spanwise divisions for panel considered.
25	NC – Number of chordwise divisions for panel considered.



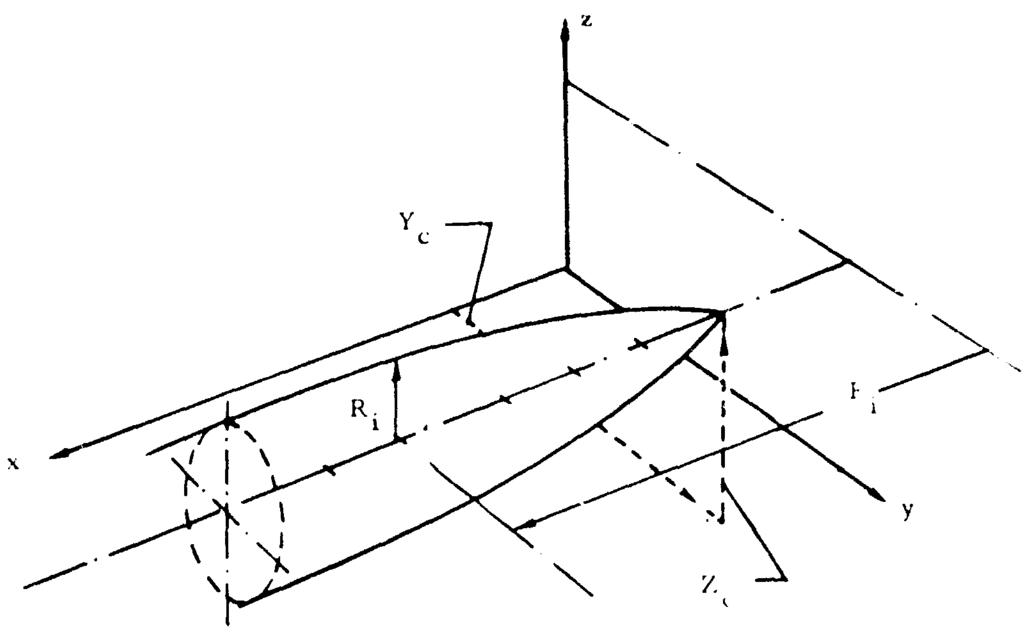
SKETCH 2.1.2-1

Item No.	Description
26	COEF – Scale factor for panel deflection modes. If no scale factor is desired, must be set to 1.0.
27	θ_i – Chordwise divisions in fraction of chord. Usually varies from 0 at leading edge to 1.0 at the trailing edge.
28	τ_i – Spanwise divisions in fraction of panel span. Usually 0.0 at inboard chord and 1.0 at outboard chord.

Repeat all panel data per panel (Items 16 through 28) Panels are input in the following sequence: wing, tail, etc., panels, then body interference panels.

29	Z_c – Z-coordinate of body axis.
30	Y_c – Y-coordinate of body axis.
31	NF – Number of divisions on body.
32	NZ – If "1", the program will allow for doublets in the Z-direction and thus will be able to account for Z-or upwash. If not, set NZ = 0.
33	NY – If "1", program will allow for Y-doublets and thus Y-or sidewash.
34	COEF – Scale factor for body deflection mode.
35	MK1– Each body has associated with it interference lifting surfaces. MK1 represents the first box on these surfaces.
36	MK2– The last box on the body interference lifting surface panels. Interference lifting surface panels are input after the regular lifting surfaces are input.
37	F – Endpoints of body divisions (starts at leading edge and ends at trailing edge). F x coordinates of body element end points.
38	RAD – Radius at endpoints.

Repeat all body data per body (Items 29 through 38)



SKETCH 2.1.2-2

Item No.	Description
39	NSTRIP – Total number of strips on all lifting surfaces.
40	NB1 – Sequence number of first strip. Omit if no AIC's are desired.
41	NB2 – Sequence number of last strip. Omit if no AIC's are desired.
42	NPR1 – Print flag. If "1", print all AIC solutions. Otherwise use "0" (usually = 0).
43	NPR2 – Print flag. If "1", print AIC's. Otherwise use "0" (usually = 0)
44	NPR3 – Stability derivative flag. If "1", print static stability derivatives. If "3", print static-and dynamic stability derivatives. Otherwise use "0". Note that, if NPR3 = 3, NRF must be > 2 and FR(1) must be 0.0. Usual setting is NPR3=1.
45	JOBNO – AIC tape identification. Ignore if no AIC's.
46	JOBNO2 – Not used.
47	NGUST – Gust flag. Use "1" for gust, "0" otherwise.

Item No.	Description
48	JSP — Second symmetry plane (the plane Z = 0). -1 ground effect (antisymmetric) 1 biplane or jet (symmetric) 0 no symmetry
49	NPC — Mode selector for AIC generation. Ignore if no AIC's. Use "0" if alternative #1 is used i. e. plunging, pitching, control surface rotation and tab rotation. Use "1" if alternative #2 is used, i. e., three cambering modes plus control surface and tab rotation.
50	NSV — Total number of strips on all vertical panels which lie on the symmetry plane Y = 0. Vertical panels lying on Y = 0 must be input before the other panels. For example the vertical portion of the T-tail must be input first.
51	NBV — Total number of boxes on vertical panels.
52	NYAW - Stability derivative override flag. If "1", yaw coefficients will be calculated, if "0", pitch coefficients will be calculated. If NDELT = 1, NYAW = 0 NDELT = -1, NYAW = 1 NDELT = 0, NYAW = 0 or 1
53	GZRO - Gust reference plane dihedral in degrees. For 0 dihedral (GZRO = 0) the gust velocities are vertical (in the Z-direction). Omit if gust is not desired.
54	XZRO - Gust reference point. Point at which sinusoidal gust velocity is unity. Omit if gust is not desired.

Item No.	Description
55	VEL – Aircraft velocity in. /sec. Omit if gust is not desired.
56	WG – Gust vertical velocity at XZRO, in. /sec. Omit if gust is not desired.

Omit the gust card if the gust is not desired. (Items 53 through 56)

57	LIM – Summation limits for chordwise integration. Usually LIM1 is the first box in a strip and LIM2 is the last box where all boxes are numbered consecutively.
58	NOP – Panel number.
59, 60, 61 62, 63, 64 65	IS1 IS2 IS3 IS4 IS5 IS6 IS7 – AIC degree-of-freedom selector. If alternative #1 is used (i. e. if NPC = 0) then IS1 through IS6 (IS7 not used) represent: plunging, pitching, control surface rotation, tab rotation, control surface plunging, tab plunging, respectively. If Alternative #2 is used then IS1 through IS7 represent: three cambering modes on the main surface, control surface rotation, tab rotation, control surface plunging, and tab plunging, respectively.
66	XHI – Reference axes measured in fractions of local chord on the inboard edge of a panel. (Further description following XHO.) Ignore if AIC's are not needed.
67	XHO – Reference axes measured in fractions of local chord on the outboard edge of a panel. For Alternative #1 5 quantities are needed: the elastic axis, the leading edge of the control surface, the rotation point of the control surface, the tab leading edge and rotation point, respectively. The data pair XHI and XHO are repeated for each panel.

Item No.	Description
	Omit data Items #58 through #67 if AIC's are not required.
68	NM, NMD – Total number of modes, i.e., max NQ.
69	NT, NTA – Total number of ARQ values.
70	N5 – If "1", save the quasi-inverse on tape so that future modes may be considered. Otherwise set to "0".
71	N6 – Type of mode input flag 0 - polynomial 1 - input h, dh/dx from tape 2 - input h, dh/dx from cards
72	N7 – If "1", calculate pressure forces and moments. Use "0" otherwise.
73	NTPI -Quasi Inverse tape identification. Written on tape when Quasi Inverse is formed and used to identify the Quasi Inverse when it is retrieved for additional mode cases.
74	NTPM - Identification of input mode (h, dh/dx) tape.

The input to follow is associated with the input modes. Equations will be written to define the variables. For panels (lifting surfaces) the deflections will be normal to the surface while for bodies the deflections will be in the Z- (if any) and Y- (if any) directions. For the "NR"th panel or body the deflections in the "NQ"th mode are calculated as follows:

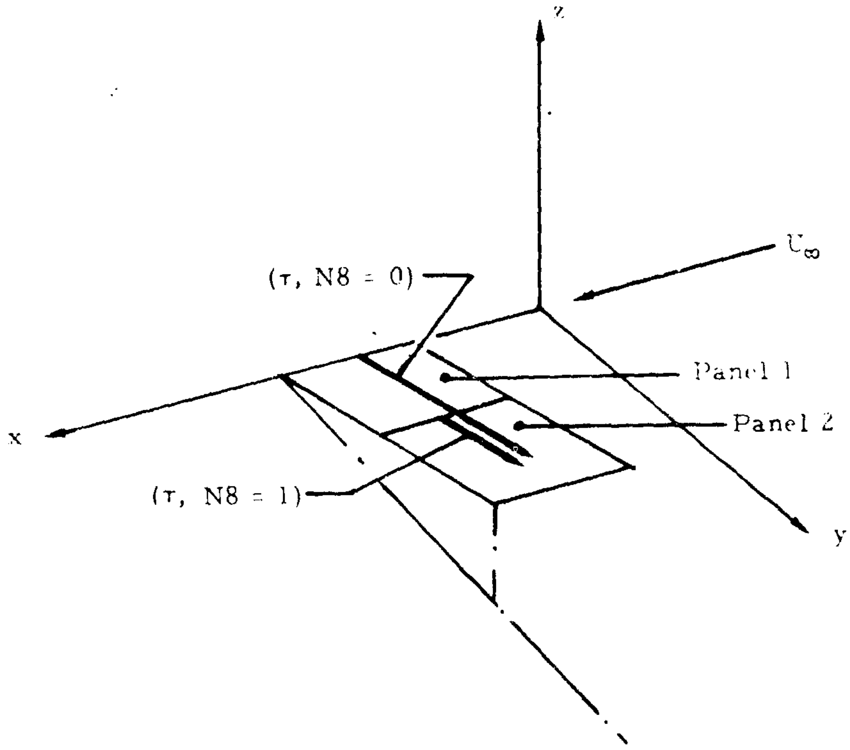
$$(f)^{(NR)}_{NQ} = COEF^{(NR)} \sum_{N=0,1,\cdots} \sum_{M=0,1,\cdots} \left(\frac{x}{s}\right)^N \left(\frac{r}{s}\right)^M ARQ_{(NR,NQ,N,M)}$$

where r is in a radial direction. The origin of the radius is either at the

origin of coordinates, when N8 = 0, or at the inboard edge (for the panel) or the axis (for a body) if N8 is set to 1.*

$$\tau = \sqrt{(y - (N8)Y_1^{(NR)})^2 + (z - (N8)Z_1^{(NR)})^2} \quad \text{for panels}$$

$$\tau = \sqrt{(y - (N8)Y_c^{(NR)})^2 + (z - (N8)Z_c^{(NR)})^2} \quad \text{for bodies}$$



SKETCH 2.1.2-3

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* Since each panel is planar, τ is a spanwise distance in the plane measured from its inboard edge or from the origin $y = z = 0$; τ is a radial distance only in the sense that each panel may have a different dihedral. The use of this radial distance is not meant to imply that the panels are curved.

Item No.	Description
75	MP, NMTP – Total number of ARQ coefficients for panels only.
76	MB, NMTB – Total number of ARQ coefficients for bodies.
77	NR – Panel number and/or body number.
78	NQ – Mode number.
79	NA, NARQ – Number of terms (ARQ) in mode NQ, panel and/or body NR.
80	N8 – Flag that sets origin of radial variable . If "0", the x-axis is used. If "1", inboard edge or axis of body is used as origin (see equation for τ).

The four items NR, NQ, NA, N8 are repeated for each panel or body until all panels and bodies are mentioned. Even if a panel or body is not in motion (NA = 0) the set of four items must be given.

The direction of motion of a body is given by the NZ or NY flags. Thus if body pitching is given and NY is flagged, then the body will be given a yaw. If a body can move in both the Z and Y directions (a nacelle) then it must be replaced with two bodies: one with NZ = 1 and one with NY = 1.

Item No.	Description
81	N, LARQ(1) – Power of x/s in the mode polynomial.
82	M, LARQ(2) – Power of τ/s in the mode polynomial.
83	ARQ – Coefficient of $(x/s)^N$ $(\tau/s)^M$ in the mode polynomial.

Omit modal data cards if modes are not desired (Items 68 through 83).

If modes are input using the options N6=1, or N6=2, omit Items 73 through 83, and add the following data items:

Item No.			
84	NBØX	-	Total number of boxes on all panels.
85	$\underline{B}$	-	Generalized force integration matrix (box area) X (displacement 1/4-chord of box).
86	$\underline{H}$	-	Displacement of 3/4-chord point normalized by semispan, h/s.
87	DH1	-	Derivative of normalized displacement by (x/s) at 3/4-chord point of box. d(h/s)/d(x/s).
88	NBEL	-	Total number of body elements.
89	$\underline{B}$	-	Generalized force integration matrix (body element length) X (diameter) X (displacement 1/2 -chord of element).
90	$\underline{H}$	-	Displacement of 1/2-chord point normalized by semispan, h/s.
91	DH1	-	Derivative of normalized displacement by (x/s) at 1/2-chord point of element. d(h/s)/d(x/s).
92	DH2	-	$d^2(h/s)/d(x/s)^2$.

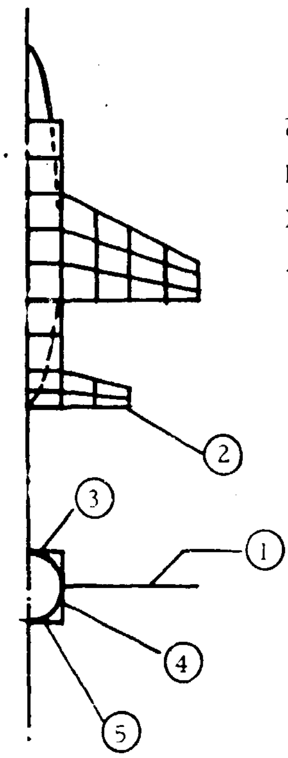
NOTE: If N6=1, Items #84 through #92 are input from cards according to the formats shown on page 8.

If N6=2, Items #84 through #92 are read from tape unit MTAPE, as one record per variable, NBØX, (B_i, i = 1, NBØX), (H_i, i = 1, NBØX) and ($DH1_i$, i = 1, NBØX). If bodies are also present, five more variables are read from tape unit MTAPE; again, as one record per variable: NBEL, (B_i, i = 1, NBEL), (H_i, i = 1, NBEL), ($DH1_i$, i = 1, NBEL) and ($DH2_i$, i = 1, NBEL).

For each additional mode, repeat Items #85 through #92.

2.2 Example Case

The following case is to be viewed only as an example of the proper input procedure and not as an example of an ideal or optimum idealization. The configuration is shown in Sketch 2.2-1.



$\bar{c} = 2.0$

$k_r = 1.0$

$M = 0.8$

$A = 8.0$

$R = 6.0$

Sketch 2.2-1

The fuselage is divided up into 10 equal elements for the slender body calculation. The divisions along with the radius is given as follows:

F_k = 0, 1.0, 2.0, 3.0, 4.0, 5.0, 6.0, 7.0, 8.0, 9.0, 10.0

RAD_k = 0, 0.7, 0.8, 0.9, 0.95, 1.0, 0.9, 0.8, 0.7, 0.5, 0.0

The axis of the fuselage lies on the x-axis, $Z_c = Y_c = 0$ and it is assumed that the fuselage moves only in the z-direction (NZ = 1). The modes of

oscillation are symmetric (δ = 1.0) pitching about the middle of the fuselage and plunging

$h/s = -5.0 + 5\,x/s$ (where s = 5)

$h/s = 1.0$

These modes apply to the entire configuration. The panels are numbered from 1 to 5 in Sketch 2.2-1.

The panels are given as follows:

(1) $X_1 = 4.0$, $X_2 = 7.0$, $X_3 = 6.0$, $X_4 = 7.0$

$Y_1 = 1.0$, $Y_2 = 5.0$, $Z_1 = 0$, $Z_2 = 0$

θ = 0, 0.333, 0.666, 1.0, τ = 0, 0.25, 0.50, 0.75, 1.0

(2) $X_1 = 9$, $X_2 = 10$, $X_3 = 9.5$, $X_4 = 10.0$

$Y_1 = 1.0$, $Y_2 = 3.0$, $Z_1 = 0$, $Z_2 = 0$

θ = 0, 0.5, 1.0

τ = 0, 0.5, 1.0

(3) $X_1 = 2.0$, $X_2 = 10.0$, $X_3 = 2.0$, $X_4 = 10.0$

$Y_1 = 0$, $Y_2 = 1.0$, $Z_1 = 1.0$, $Z_2 = 1.0$

θ = 0, 0.125, 0.25, 0.375, 0.50, 0.625, 0.75, 0.875, 0.9375, 1.0

0, 1.0

(4) X_1, X_2, X_3, X_4, θ same as (3)

$Y_1 = 1.0$, $Y_2 = 1.0$, $Z_1 = 1.0$, $Z_2 = -1.0$

τ = 0, 0.5, 1.0

(5) X_1, X_2, X_3, X_4, θ, τ same as (3)

$Y_1 = 1.0$, $Y_2 = 0.0$, $Z_1 = -1$, $Z_2 = -1$

The input sheets are shown on the next several pages. The output is shown on the subsequent pages.

2.2.1 Input Sheets

ENGINEER ______ PHONE ______ DATE ______

PUNCH IN ALL CARDS CASE 63 64 65 66 67 68 | PROGRAM NO. 73 74 75 76: H 7 W C

Cols 1–10	Cols 11–20	Cols 21–30	Cols 31–40	Cols 41–50	Cols 51–60	SEQ. NO. (77–80)
		HEADER				
H7WG TEST	CASE	WING-BODY-TAIL				01
M	A	$\bar{c}$	s	ε NP NB NT	NCØRE	
0.8	16.0	2.0	5.0	1 5 1 1	104 0 0 0 0	02
		KR_i	i = 1, NRE			
1.0						03
X1	X2	X3	X4	Y1	Y2	
4.0	7.0	6.0	7.0	1.0	5.0	04
Z1	Z2	NS NC	CØEF			
0.0	0.0	5 4	1.0			05
		θ_i	i = 1, NC			
0.0	0.33333	0.666667	1.0			06
		r_i	i = 1, NS			
0.0	0.25	0.50	0.75	1.0		07
9.0	10.0	9.5	10.0	1.0	3.0	
0.0	0.0	3 3	1.0			
0.0	0.5	1.0				

Cards 04–07: REPEAT PER PANEL (1)

Last three cards: (2)

DIRECTIONS FOR KEYPUNCH DO NOT PUNCH BLANK COLUMNS ______ NO UNDERPUNCHES IN SIGN FIELDS

ENGINEER ______ PHONE ______ DATE ______

PUNCH IN ALL CARDS ______ CASE ______ PROGRAM NO. H 7 W C

1–10	11–20	21–30	31–40	41–50	51–60	SEQ. NO. 77–80	
0.0	0.5	1.0					
2.0	10.0	2.0	10.0	0.0	1.0		(3)
1.0	1.0	2 10	1.0				(3)
0.0	0.125	0.25	0.375	0.5	0.625		(3)
0.75	0.875	0.9375	1.0				(3)
0.0	1.0						(3)
2.0	10.0	2.0	10.0	1.0	1.0		(4)
1.0	-1.0	3 10	1.0				(4)
0.0	0.125	0.25	0.375	0.5	0.625		(4)
0.75	0.875	0.9375	1.0				(4)

DIRECTIONS FOR KEYPUNCH DO NOT PUNCH BLANK COLUMNS NO UNDERPUNCHES IN SIGN FIELDS

ENGINEER ______ PHONE ______ DATE ______

PUNCH IN ALL CARDS CASE 53 54 55 56 57 58 PROGRAM NO. 73 74 75 76 H 7 W C

1–10	11–20	21–30	31–40	41–50	51–60	SEQ. NO. 77–80
0.0	0.5	1.0				
2.0	10.0	2.0	10.0	1.0	0.0	
-1.0	-1.0	2 10	1.0			
0.0	0.125	0.25	0.375	0.5	0.625	
0.75	0.875	0.9375	1.0			
0.0	1.0					
Z_C	Y_C	NF NZ NY	CØEFF	MK1 MK2		
0.0	0.0	1 1 1	1.0	17 52		08
		F_K ,	K = 1, NF			
0.0	1.0	2.0	3.0	4.0	5.0	09
6.0	7.0	8.0	9.0	10.0		
		RAD_K ,	k = 1, NF			
0.0	0.7	0.8	0.9	0.95	1.0	10

(5)

REPEAT PER BODY

DIRECTIONS FOR KEYPUNCH DO NOT PUNCH BLANK COLUMNS NO UNDERPUNCHES IN SIGN FIELDS

ENGINEER ______ PHONE ______ DATE ______

PUNCH IN ALL CARDS   CASE (63–68) ______   PROGRAM NO. (73–76) H 7 W C

Cols 1–10	Cols 11–20	Cols 21–30	Cols 31–40	Cols 41–50	Cols 51–60	SEQ. NO. (77–80)
0.90	0.80	0.70	0.5	0.0		
NSTRIP NB1 NB2	NPR1 NPR2 NPR3	JØBNØ	JØBNØ2	NGUST JSP NPC	NSV NBV NY	11
1 0	0 0 0			0	0 0	
LIM1 LIM2 LIM3	. . .	LIM	j = 1, NSTRIP			13
1 3	4 6	7 9	10 12	13 14	15 16	
17 25	26 34	35 43	44 52			
NM NT N5 N6 N7	NTPI	NTPM	MP MB			17
2 15 0 0 1			12 3			
NR NQ NA N8	NR NQ NA N8	. . .	i = 1, (NM)	(NP)		18
1 1 2 1	2 1 2 1	3 1 0 1	4 1 0 1	5 1 0 1	1 2 1 1	
2 2 1 1	3 2 0 1	4 2 0 1	5 2 0 1			
N M	ARQ		i = 1, MP			19
0 0	-5.0	1.0	5.0	0.0	-5.0	
1.0	5.0	0.0	-5.0	1.0	5.0	
0.0	5.0	1.0	-5.0	0.0	7.0	

PANEL MODES

ENGINEER ______ PHONE ______ DATE ______

PUNCH IN ALL CARDS   CASE (63 64 65 66 67 68) [ ]   PROGRAM NO. (73 74 75 76) H 7 W C

± 1–10	± 11–20	± 21–30	± 31–40	± 41–50	± 51–60	SEQ. NO. 77–80
0.0	1.0	0.0	1.0	0.0	-1.0	
NR NQ NA N8 1 1 2	1 2 1		i = 1, (NM) (NB)			20
N M 0 0	ARQ -5.0	1.0	i = 1, MB 5.0	0.0	1.0	21

BODY MODES

DIRECTIONS FOR KEYPUNCH   DO NOT PUNCH BLANK COLUMNS ______ NO UNDERPUNCHES IN SIGN FIELDS.

2.2.2 Output

```
WTWC  TEST CASE    WING-BODY-TAIL
                        **  ARRAY OF REDUCED FREQUENCIES  **

      1.000000
     REF. CHORD =        2.00000  REF. SEMI-SPAN =       5.00000  REF. AREA =       16.0
    MACH NO. =     0.80000   BETA =     0.60000

                     *** PANEL NO.    1  INPUT VALUES ***
  X1 =    4.000000  X2 =    7.000000  Y1 =    1.000000  Z1 =    0.0
  X3 =    6.000000  X4 =    7.000000  Y2 =    5.000000  Z2 =    0.0
  NC =  4  NS =  5  NOELT =  1  NO. OF PANELS =  5

                        4  CHORDWISE DIVISIONS FOR PANEL  1

   0.0              0.33332998E 00    0.66666698E 00    0.10000000E 01
                        5   SPANWISE DIVISIONS FOR PANEL  1

   0.0              0.25000000E 00    0.50000000E 00    0.75000000E 00    0.10000000E 01
                                   20  ***  XI ELEMENTS FOR PANEL  1***
   0.40000000E 01    0.49999895E 01    0.60000010E 01    0.70000000E 01    0.45000000E 01    0.53333244E 01
   0.61666670E 01    0.70000000E 01    0.50000000E 01    0.56666594E 01    0.63333340E 01    0.70000000E 01
   0.55000000E 01    0.59999943E 01    0.65000000E 01    0.70000000E 01    0.60000000E 01    0.63333292E 01
   0.66666570E 01    0.70000000E 01
                                   20  *** ETA ELEMENTS FOR PANEL  1***
   0.10000000E 01    0.10000000E 01    0.10000000E 01    0.10000000E 01    0.20000000E 01    0.20000000E 01
   0.20000000E 01    0.20000000E 01    0.30000000E 01    0.30000000E 01    0.30000000E 01    0.30000000E 01
   0.40000000E 01    0.40000000E 01    0.40000000E 01    0.40000000E 01    0.50000000E 01    0.50000000E 01
   0.50000000E 01    0.50000000E 01
                                      20 ZEE ELEMENTS FOR PANEL NO.   1

   0.0               0.0               0.0               0.0               0.0               0.0
   0.0               0.0               0.0               0.0               0.0               0.0
   0.0               0.0               0.0               0.0               0.0               0.0
   0.0               0.0
                                   4  *** XI-J ELEMENTS FOR PANEL  1***
   0.42500000E 01    0.47500000E 01    0.52500000E 01    0.57500000E 01
                    C.WIGGLES FOR PANEL NO.   1 *****
   0.27500000E 01    0.22499990E 01    0.17500000E 01    0.12500000E 01
                    *** PANEL NO.    2  INPUT VALUES ***
  X1 =    9.000000  X2 =   10.000000  Y1 =    1.000000  Z1 =    0.0
  X3 =    9.500000  X4 =   10.000000  Y2 =    3.000000  Z2 =    0.0
  NC =  3  NS =  3  NOELT =  1  NO. OF PANELS =  5

                        3  CHORDWISE DIVISIONS FOR PANEL  2

   0.0              0.50000000E 00    0.10000000E 01
                        3   SPANWISE DIVISIONS FOR PANEL  2

   0.0              0.50000000E 00    0.10000000E 01
                                   9  ***  XI ELEMENTS FOR PANEL  2***
   0.90000000E 01    0.95000000E 01    0.10000000E 02    0.92500000E 01    0.96250000E 01    0.10000000E 02
   0.95000000E 01    0.97500000E 01    0.10000000E 02
                                   9  *** ETA ELEMENTS FOR PANEL  2***
   0.10000000E 01    0.10000000E 01    0.10000000E 01    0.20000000E 01    0.20000000E 01    0.20000000E 01
   0.30000000E 01    0.30000000E 01    0.30000000E 01
                                      9 ZEE ELEMENTS FOR PANEL NO.   2

   0.0               0.0               0.0               0.0               0.0               0.0
   0.0               0.0               0.0
                                   2  *** XI-J ELEMENTS FOR PANEL  2***
   0.91250000E 01    0.93750000E 01
                    C.WIGGLES FOR PANEL NO.   2 *****
   0.87500000E 00    0.62500000E 00
                    *** PANEL NO.    3  INPUT VALUES ***
  X1 =    2.000000  X2 =   10.000000  Y1 =    0.0        Z1 =    1.000000
```

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X3 =    2.000000  X4 =   10.000000  Y2 =    1.000000  Z2 =    1.000000
NC = 10  NS =  2  NOELT =  1  NO. OF PANELS =  5

                    10  CHORDWISE DIVISIONS FOR PANEL  3

0.0              0.12500000E 00   0.25000000E 00   0.37500000E 00   0.50000000E 00   0.62500000E 00
0.75000000E 00   0.87500000E 00   0.93750000E 00   0.10000000E 01
                    2   SPANWISE DIVISIONS FOR PANEL  3

0.0              0.10000000E 01
                              20  ***  XI ELEMENTS FOR PANEL  3***
0.20000000E 01   0.30000000E 01   0.40000000E 01   0.50000000E 01   0.60000000E 01   0.70000000E 01
0.80000000E 01   0.90000000E 01   0.95000000E 01   0.10000000E 02   0.20000000E 01   0.30000000E 01
0.40000000E 01   0.50000000E 01   0.60000000E 01   0.70000000E 01   0.80000000E 01   0.90000000E 01
0.95000000E 01   0.10000000E 02
                              20  *** ETA ELEMENTS FOR PANEL  3***
0.0              0.0              0.0              0.0              0.0              0.0
0.0              0.0              0.0              0.0              0.10000000E 01   0.10000000E 01
0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01
0.10000000E 01   0.10000000E 01
                                20 ZFF ELEMENTS FOR PANEL NO.   3

0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01
0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01
0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01
0.10000000E 01   0.10000000E 01
                              1  *** XI-J ELEMENTS FOR PANEL  3***
0.20000000E 01
                   C.WIGGLES FOR PANEL NO.   3 *****
0.80000000E 01
                   *** PANEL NO.   4  INPUT VALUES ***
X1 =    2.000000  X2 =   10.000000  Y1 =    1.000000  Z1 =    1.000000
X3 =    2.000000  X4 =   10.000000  Y2 =    1.000000  Z2 =   -1.000000
NC = 10  NS =  3  NOELT =  1  NO. OF PANELS =  5

                    10  CHORDWISE DIVISIONS FOR PANEL  4

0.0              0.12500000E 00   0.25000000E 00   0.37500000E 00   0.50000000E 00   0.62500000E 00
0.75000000E 00   0.87500000E 00   0.93750000E 00   0.10000000E 01
                    3   SPANWISE DIVISIONS FOR PANEL  4

0.0              0.50000000E 00   0.10000000E 01
                              30  ***  XI ELEMENTS FOR PANEL  4***
0.20000000E 01   0.30000000E 01   0.40000000E 01   0.50000000E 01   0.60000000E 01   0.70000000E 01
0.80000000E 01   0.90000000E 01   0.95000000E 01   0.10000000E 02   0.20000000E 01   0.30000000E 01
0.40000000E 01   0.50000000E 01   0.60000000E 01   0.70000000E 01   0.80000000E 01   0.90000000E 01
0.95000000E 01   0.10000000E 02   0.20000000E 01   0.30000000E 01   0.40000000E 01   0.50000000E 01
0.60000000E 01   0.70000000E 01   0.80000000E 01   0.90000000E 01   0.95000000E 01   0.10000000E 02
                              30  *** ETA ELEMENTS FOR PANEL  4***
0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01
0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01
0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01
0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01
0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01
                                30 ZLE ELEMENTS FOR PANEL NO.   4

0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01
0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.0              0.0
0.0              0.0              0.0              0.0              0.0              0.0
0.0              0.0             -0.10000000E 01  -0.10000000E 01  -0.10000000E 01  -0.10000000E 01
-0.10000000E 01  -0.10000000E 01  -0.10000000E 01  -0.10000000E 01  -0.10000000E 01  -0.10000000E 01
                              2  *** XI-J ELEMENTS FOR PANEL  4***
0.20000000E 01   0.20000000E 01
                   C.WIGGLES FOR PANEL NO.   4 *****
0.80000000E 01   0.80000000E 01
                   *** PANEL NO.   5  INPUT VALUES ***
```


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```
X1 =   2.000000  X2 =   10.000000  Y1 =   1.000000  Z1 =  -1.000000
X3 =   2.000000  X4 =   10.000000  Y2 =   0.0       Z2 =  -1.000000
NC = 10  NS = 2  NOFLT = 1  NO. OF PANELS = 5

              10  CHORDWISE DIVISIONS FOR PANEL  5

0.0              0.12500000E 00   0.25000000E 00   0.37500000E 00   0.50000000E 00   0.62500000E 00
0.75000000E 00   0.87500000E 00   0.93750000E 00   0.10000000E 01
               2  SPANWISE DIVISIONS FOR PANEL  5

0.0              0.10000000E 01
                        20  *** XI ELEMENTS FOR PANEL  5***
0.20000000E 01   0.30000000E 01   0.40000000E 01   0.50000000E 01   0.60000000E 01   0.70000000E 01
0.80000000E 01   0.90000000E 01   0.95000000E 01   0.10000000E 02   0.20000000E 01   0.30000000E 01
0.40000000E 01   0.50000000E 01   0.60000000E 01   0.70000000E 01   0.80000000E 01   0.90000000E 01
0.95000000E 01   0.10000000E 02
                        20  *** ETA ELEMENTS FOR PANEL  5***
0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01
0.10000000E 01   0.10000000E 01   0.10000000E 01   0.10000000E 01   0.0              0.0
0.0              0.0              0.0              0.0              0.0              0.0
0.0              0.0
                        20 ZEE ELEMENTS FOR PANEL NO.  5

-0.10000000E 01  -0.10000000E 01  -0.10000000E 01  -0.10000000E 01  -0.10000000E 01  -0.10000000E 01
-0.10000000E 01  -0.10000000E 01  -0.10000000E 01  -0.10000000E 01  -0.10000000E 01  -0.10000000E 01
-0.10000000E 01  -0.10000000E 01  -0.10000000E 01  -0.10000000E 01  -0.10000000E 01  -0.10000000E 01
-0.10000000E 01  -0.10000000E 01
                        1  *** XI-J ELEMENTS FOR PANEL  5***
0.20000000E 01
              C.WIGGLES FOR PANEL NO.   5 *****
0.80000000E 01
12    16    25    41    52
              5 DIHEDRAL ANGLES FOR ALL PANELS

0.0              0.0              0.0              -0.89999954E 02  0.18000000E 03
                        52  *** -X- ELEM. FOR ALL PANELS ***
0.49374905E 01   0.58541672E 01   0.67708321E 01   0.53124924E 01   0.60624962E 01   0.68124981E 01
0.56874924E 01   0.62708302E 01   0.68541660E 01   0.60624943E 01   0.64791641E 01   0.68958321E 01
0.94531250E 01   0.98906250E 01   0.96093750E 01   0.99218750E 01   0.27500000E 01   0.37500000E 01
0.47500000E 01   0.57500000E 01   0.67500000E 01   0.77500000E 01   0.87500000E 01   0.93750000E 01
0.98750000E 01   0.27500000E 01   0.37500000E 01   0.47500000E 01   0.57500000E 01   0.67500000E 01
0.77500000E 01   0.87500000E 01   0.93750000E 01   0.98750000E 01   0.27500000E 01   0.37500000E 01
0.47500000E 01   0.57500000E 01   0.67500000E 01   0.77500000E 01   0.87500000E 01   0.93750000E 01
0.98750000E 01   0.27500000E 01   0.37500000E 01   0.47500000E 01   0.57500000E 01   0.67500000E 01
0.77500000E 01   0.87500000E 01   0.93750000E 01   0.98750000E 01
                        52  *** XI-V ELEMENTS ALL PANELS ***
0.44791641E 01   0.53958254E 01   0.63125000E 01   0.49374971E 01   0.56874933E 01   0.64375000E 01
0.53958311E 01   0.59791613E 01   0.65625000E 01   0.58541651E 01   0.62708282E 01   0.66875000E 01
0.92343750E 01   0.96718750E 01   0.94531250E 01   0.97656250E 01   0.22500000E 01   0.32500000E 01
0.42500000E 01   0.52500000E 01   0.62500000E 01   0.72500000E 01   0.82500000E 01   0.91250000E 01
0.96250000E 01   0.22500000E 01   0.32500000E 01   0.42500000E 01   0.52500000E 01   0.62500000E 01
0.72500000E 01   0.82500000E 01   0.91250000E 01   0.96250000E 01   0.22500000E 01   0.32500000E 01
0.42500000E 01   0.52500000E 01   0.62500000E 01   0.72500000E 01   0.82500000E 01   0.91250000E 01
0.96250000E 01   0.22500000E 01   0.32500000E 01   0.42500000E 01   0.52500000E 01   0.62500000E 01
0.72500000E 01   0.82500000E 01   0.91250000E 01   0.96250000E 01
                        52  *** XI-L ELEMENTS ALL PANELS ***
0.42499971E 01   0.52499914E 01   0.62500000E 01   0.47083311E 01   0.55416594E 01   0.63750000E 01
0.51666641E 01   0.58333274E 01   0.65000000E 01   0.56249981E 01   0.61249952E 01   0.66250000E 01
0.91250000E 01   0.96250000E 01   0.93437500E 01   0.97187500E 01   0.22500000E 01   0.32500000E 01
0.42500000E 01   0.52500000E 01   0.62500000E 01   0.72500000E 01   0.82500000E 01   0.91250000E 01
0.96250000E 01   0.22500000E 01   0.32500000E 01   0.42500000E 01   0.52500000E 01   0.62500000E 01
0.72500000E 01   0.82500000E 01   0.91250000E 01   0.96250000E 01   0.22500000E 01   0.32500000E 01
0.42500000E 01   0.52500000E 01   0.62500000E 01   0.72500000E 01   0.82500000E 01   0.91250000E 01
0.96250000E 01   0.22500000E 01   0.32500000E 01   0.42500000E 01   0.52500000E 01   0.62500000E 01
0.72500000E 01   0.82500000E 01   0.91250000E 01   0.96250000E 01
                        42  *** XI-2 ELEMENTS ALL PANELS ***
```


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0.57083333E 01	0.55416594E 01	0.63750000E 01	0.51666661E 01	0.58333273E 01	0.65000000E 01
0.56249996E 01	0.61249952E 01	0.66250000E 01	0.60833321E 01	0.64166627E 01	0.67500000E 01
0.93437500E 01	0.97187500E 01	0.95625000E 01	0.98125000E 01	0.22500000E 01	0.32500000E 01
0.42500000E 01	0.52500000E 01	0.62500000E 01	0.72500000E 01	0.82500000E 01	0.91250000E 01
0.96250000E 01	0.22500000E 01	0.32500000E 01	0.42500000E 01	0.52500000E 01	0.62500000E 01
0.72500000E 01	0.82500000E 01	0.91250000E 01	0.96250000E 01	0.22500000E 01	0.32500000E 01
0.42500000E 01	0.52500000E 01	0.62500000E 01	0.72500000E 01	0.82500000E 01	0.91250000E 01
0.96250000E 01	0.22500000E 01	0.32500000E 01	0.42500000E 01	0.52500000E 01	0.62500000E 01
0.72500000E 01	0.82500000E 01	0.91250000E 01	0.96250000E 01		

52 *** -Y- ELEM. FOR ALL PANELS ***

0.15000000E 01	0.15000000E 01	0.15000000E 01	0.25000000E 01	0.25000000E 01	0.25000000E 01
0.35000000E 01	0.35000000E 01	0.35000000E 01	0.45000000E 01	0.45000000E 01	0.45000000E 01
0.15000000E 01	0.15000000E 01	0.25000000E 01	0.25000000E 01	0.50000000E 00	0.50000000E 00
0.50000000E 00	0.50000000E 00	0.50000000E 00	0.50000000E 00	0.50000000E 00	0.50000000E 00
0.50000000E 00	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.50000000E 00	0.50000000E 00	0.50000000E 00	0.50000000E 00	0.50000000E 00
0.50000000E 00	0.50000000E 00	0.50000000E 00	0.50000000E 00		

52 *** ETAY ELEMENTS ALL PANELS ***

0.15000000E 01	0.15000000E 01	0.15000000E 01	0.25000000E 01	0.25000000E 01	0.25000000E 01
0.35000000E 01	0.35000000E 01	0.35000000E 01	0.45000000E 01	0.45000000E 01	0.45000000E 01
0.15000000E 01	0.15000000E 01	0.25000000E 01	0.25000000E 01	0.50000000E 00	0.50000000E 00
0.50000000E 00	0.50000000E 00	0.50000000E 00	0.50000000E 00	0.50000000E 00	0.50000000E 00
0.50000000E 00	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.50000000E 00	0.50000000E 00	0.50000000E 00	0.50000000E 00	0.50000000E 00
0.50000000E 00	0.50000000E 00	0.50000000E 00	0.50000000E 00		

52 *** ETA1 ELEMENTS ALL PANELS ***

0.10000000E 01	0.10000000E 01	0.10000000E 01	0.20000000E 01	0.20000000E 01	0.20000000E 01
0.30000000E 01	0.30000000E 01	0.30000000E 01	0.40000000E 01	0.40000000E 01	0.40000000E 01
0.10000000E 01	0.10000000E 01	0.20000000E 01	0.20000000E 01	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01		

52 *** ETA2 ELEMENTS ALL PANELS ***

0.20000000E 01	0.20000000E 01	0.20000000E 01	0.30000000E 01	0.30000000E 01	0.30000000E 01
0.40000000E 01	0.40000000E 01	0.40000000E 01	0.50000000E 01	0.50000000E 01	0.50000000E 01
0.20000000E 01	0.20000000E 01	0.30000000E 01	0.30000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0		

52 Z ELEMENTS FOR ALL PANELS

0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.50000000E 00	0.50000000E 00	0.50000000E 00	0.50000000E 00	0.50000000E 00
0.50000000E 00	0.50000000E 00	0.50000000E 00	0.50000000E 00	-0.50000000E 00	-0.50000000E 00
-0.50000000E 00	-0.50000000E 00	-0.50000000E 00	-0.50000000E 00	-0.50000000E 00	-0.50000000E 00
-0.50000000E 00	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01
-0.10000000E 01	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01		

52 Z-Y ELEMENTS FOR ALL PANELS

0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01

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0.10000000E 01	0.50000000E 00	0.50000000E 00	0.50000000E 00	0.50000000E 00	0.50000000E 00
0.50000000E 00	0.50000000E 00	0.50000000E 00	0.50000000E 00	-0.50000000E 00	-0.50000000E 00
-0.50000000E 00	-0.50000000E 00	-0.50000000E 00	-0.50000000E 00	-0.50000000E 00	-0.50000000E 00
-0.50000000E 00	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01
-0.10000000E 01	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01		

52 Z-1 ELEMENTS FOR ALL PANELS

0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01
-0.10000000E 01	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01		

52 Z-2 ELEMENTS FOR ALL PANELS

0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	-0.10000000E 01	-0.10000000E 01
-0.10000000E 01	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01
-0.10000000E 01	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01
-0.10000000E 01	-0.10000000E 01	-0.10000000E 01	-0.10000000E 01		

***** SDELT ELEM. FOR ALL PANELS *****

0.91666569E 00	0.91667700E 00	0.91666603E 00	0.74999149E 00	0.75000854E 00	0.74999952E 00
0.58332682E 00	0.58333401E 00	0.58333302E 00	0.41666174E 00	0.41667175E 00	0.41666651E 00
0.43750000E 00	0.43751010E 00	0.31250000E 00	0.31250000E 00	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.50000000E 00
0.50000000E 00	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.50000000E ~~00~~	0.50000000E 00	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.50000000E 00
0.50000000E 00	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.50000000E 00	0.50000000E 00		
0.83332160E-01	0.41666177E 00	0.75000000E 00	0.83332062E-01	0.41666383E 00	0.75000010E 00
0.83332062E-01	0.41666353E 00	0.75000000E 00	0.83332062E-01	0.41666257E 00	0.75000000E 00
0.12500000E 00	0.62500010E 00	0.12500000E 00	0.62500000E 00	0.31250000E-01	0.15625000E 00
0.28125000E 00	0.40625000E 00	0.53125000E 00	0.65625000E 00	0.78125000E 00	0.89062500E 00
0.95312500E 00	0.31250000E-01	0.15625000E 00	0.28125000E 00	0.40625000E 00	0.53125000E 00
0.65625000E 00	0.78125000E 00	0.89062500E 00	0.95312500E 00	0.31250000E-01	0.15625000E 00
0.28125000E 00	0.40625000E 00	0.53125000E 00	0.65625000E 00	0.78125000E 00	0.89062500E 00
0.95312500E 00	0.31250000E-01	0.15625000E 00	0.28125000E 00	0.40625000E 00	0.53125000E 00
0.65625000E 00	0.78125000E 00	0.89062500E 00	0.95312500E 00		

52 NOZ WIDTHS FOR ALL PANELS

0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01		

Y-S FOR THE 10 STRIPS

0.15000000E 01	0.25000000E 01	0.35000000E 01	0.45000000E 01	0.15000000E 01	0.25000000E 01
0.50000000E 00	0.10000000E 01	0.10000000E 01	0.50000000E 00		

DELY-S FOR THE 10 STRIPS

0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.0	0.0	0.10000000E 01		

Z-S FOR THE 10 STRIPS

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0.0	0.0	0.0	0.0	0.0	0.0
0.10000000E 01	0.50000000E 00	-0.50000000E 00	-0.10000000E 01		

DELZ-S FOR THE 10 STRIPS

0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.10000000E 01	0.10000000E 01	0.0		
0.12500000E 00	0.37500000E 00	0.62500000E 00	0.87500000E 00	0.25000000E 00	0.75000000E 00
0.50000000E 00	0.25000000E 00	0.75000000E 00	0.50000000E 00		

*** BODY NO. 1 INPUT VALUES ***

CENTER OF BODY COORDINATES Y = 0.0 Z = 0.0

YFLAG = 0 ZFLAG = 1 MODE SHAPE COEFFICIENT = 1.000000

BODY BOX LIMITS = 17 52

11 BODY ELEMENTS FOR BODY NO. 1

0.0	0.10000000E 01	0.20000000E 01	0.30000000E 01	0.40000000E 01	0.50000000E 01
0.60000000E 01	0.70000000E 01	0.80000000E 01	0.90000000E 01	0.10000000E 02	

11 BODY RADII FOR BODY NO. 1

0.0	0.69999999E 00	0.79999995E 00	0.89999998E 00	0.94999999E 00	0.10000000E 01
0.89999998E 00	0.79999995E 00	0.69999999E 00	0.50000000E 00	0.0	

10 X ELEMENTS FOR ALL BODIES

0.50000000E 00	0.15000000E 01	0.25000000E 01	0.35000000E 01	0.45000000E 01	0.55000000E 01
0.65000000E 01	0.75000000E 01	0.85000000E 01	0.95000000E 01		

10 XIV ELEMENTS FOR ALL BODIES

0.50000000E 00	0.15000000E 01	0.25000000E 01	0.35000000E 01	0.45000000E 01	0.55000000E 01
0.65000000E 01	0.75000000E 01	0.85000000E 01	0.95000000E 01		

10 Y ELEMENTS FOR ALL BODIES

0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0		

10 Z ELEMENTS FOR ALL BODIES

0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0		

10 DX ELEMENTS FOR ALL BODIES

0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01
0.10000000E 01	0.10000000E 01	0.10000000E 01	0.10000000E 01		

10 RAD ELEMENTS FOR ALL BODIES

0.34999996E 00	0.74999952E 00	0.84999990E 00	0.92499971E 00	0.97499990E 00	0.94999981E 00
0.84999990E 00	0.74999952E 00	0.59999990E 00	0.25000000E 00		

END OF PART1 - BASIC DATA CALCULATIONS

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PANEL	MODE	N	M	ARG
1	1	0	0	-5.0000
1	1	1	0	5.0000
2	1	0	0	-5.0000
2	1	1	0	5.0000
1	2	0	0	1.0000
2	2	0	0	1.0000

THE 52 B-MATRIX ELEMENTS FOR MODE NO. 1

-0.19997750E-01	0.14515653E-01	0.44124921E-01	-0.14750939E-02	0.20624917E-01	0.43124884E-01
0.92354626E-02	0.22467250E-01	0.16654198E-01	0.14235880E-01	0.21180727E-01	0.28124955E-01
0.74101448E-01	0.41757774E-01	0.55664963E-01	0.59570513E-01	-0.11000001E 00	-0.69999994E-01
-0.30000035E-01	0.99999652E-02	0.69999997E-01	0.89999914E-01	0.12999988E 00	0.82499921E-01
0.92499912E-01	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.11000001E 00	0.69999994E-01	0.30000035E-01	-0.99998652E-02	-0.69999997E-01
-0.89999914E-01	-0.12999988E 00	-0.82499921E-01	-0.92499912E-01		

THE 52 W-MATRIX ELEMENTS FOR MODE NO. 1

0.50000000E 01	-0.31255245E 00	0.50000000E 01	0.42707920E 01	0.50000000E 01	0.84541508E 01
0.50000000E 01	0.15626523E 01	0.50000000E 01	0.53124666E 01	0.50000000E 01	0.90624809E 01
0.50000000E 01	0.36176475E 01	0.50000000E 01	0.63561412E 01	0.50000000E 01	0.92708111E 01
0.50000000E 01	0.53124666E 01	0.50000000E 01	0.73458158E 01	0.50000000E 01	0.96791412E 01
0.50000000E 01	0.22265625E 02	0.50000000E 01	0.24453110E 02	0.50000000E 01	0.23046875E 02
0.50000000E 01	0.24609375E 02	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	1.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0				

THE 52 B-MATRIX ELEMENTS FOR MODE NO. 2

0.30666278E-01	0.36667079E-01	0.36666639E-01	0.29999673E-01	0.30000340E-01	0.29999979E-01
0.23333073E-01	0.23333605E-01	0.23333319E-01	0.16666668E-01	0.16666867E-01	0.16666658E-01
0.17499999E-01	0.17499999E-01	0.12499999E-01	0.12499999E-01	0.39999999E-01	0.39999999E-01
0.39999999E-01	0.39999999E-01	0.39999999E-01	0.39999999E-01	0.39999999E-01	0.20000000E-01
0.20000000E-01	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	-0.39999999E-01	-0.39999999E-01	-0.39999999E-01	-0.39999999E-01	-0.39999999E-01
-0.39999999E-01	-0.39999999E-01	-0.20000000E-01	-0.20000000E-01		

THE 52 W-MATRIX ELEMENTS FOR MODE NO. 2

0.0	0.50000000E 01	0.0	0.50000000E 01	0.0	0.50000000E 01
0.0	0.50000000E 01	0.0	0.50000000E 01	0.0	0.50000000E 01
0.0	0.50000000E 01	0.0	0.50000000E 01	0.0	0.50000000E 01
0.0	0.50000000E 01	0.0	0.50000000E 01	0.0	0.50000000E 01
0.0	0.50000000E 01	0.0	0.50000000E 01	0.0	0.50000000E 01
0.0	0.50000000E 01	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0

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0.0            0.0            0.0            0.0            0.0            0.0
0.0            0.0            0.0            0.0            0.0            0.0
0.0            0.0            0.0            0.0            0.0            0.0
0.0            0.0            0.0            0.0            0.0            0.0
0.0            0.0            0.0            0.0            0.0            0.0
0.0            0.0            0.0            0.0            0.0            0.0
0.0            0.0            0.0            0.0            0.0            0.0
0.0            0.0
    BODY  MODE  N  M      ARG

     1     1  0  0     -5.0000
     1     1  1  0     -5.0000
     1     2  0  0      1.0000
                     THE  10 B-MATRIX ELEMENTS FOR MODE NO.   1
-0.62999996E-01 -0.10499990E 00 -0.44999919E-01 -0.55499990E-01 -0.19500032E-01  0.18999886E-01
 0.50999931E-01  0.74999864E-01  0.63299932E-01  0.44999961E-01
                     THE  10 WJ MATRIX ELEMENTS FOR MODE NO.   1
 0.50000000E 01 -0.22500000E 02  0.50000000E 01 -0.17500000E 02  0.50000000E 01 -0.12500000E 02
 0.50000000E 01 -0.75000048E 01  0.50000000E 01 -0.25000048E 01  0.50000000E 01  0.24999857E 01
 0.50000000E 01  0.74999409E 01  0.50000000E 01  0.12500000E 02  0.50000000E 01  0.17499985E 02
 0.50000000E 01  0.22499985E 02
                     THE  10 WJ-PRIME ELEMENTS FOR MODE NO.   1
 0.0             0.50000000E 01  0.0             0.50000000E 01  0.0             0.50000000E 01
 0.0             0.50000000E 01  0.0             0.50000000E 01  0.0             0.50000000E 01
 0.0             0.50000000E 01  0.0             0.50000000E 01  0.0             0.50000000E 01
 0.0             0.50000000E 01
COL. NO.   1  OF DEL-CP MATRIX

 0.46731171E 02 -0.47966523E 02  0.46376295E 02  0.12566156E 02  0.36520996E 02  0.18449531E 02
 0.23169989E 02  0.26703506E 02  0.92294344E 01  0.22845108E 02 -0.10607870E 02  0.24274323E 02
-0.23169174E 02  0.21391150E 02 -0.12591979E 02  0.15737945E 02 -0.39269852E 02 -0.31415768E 01
-0.33179195E 02 -0.62831787E 02
          COLUMN NO.   1 OF THE SUGA MATRIX

 0.25195149E 01 -0.50428762E 01  0.36276155E 01 -0.31553839E 01  0.37955246E 01 -0.48432014E 00
-0.76491559E 00 -0.26761684E 01 -0.11506948E-01 -0.23530371E 01  0.64120828E 00 -0.19685144E 01
-0.13914610E 01 -0.44665173E 00 -0.11610011E 01 -0.31344867E 00 -0.84853542E 00 -0.10862694E 01
-0.98471480E 00  0.17044535E 00 -0.10257364E 01  0.21967799E 00 -0.10012159E 01  0.52393429E-01
 0.18112531E 01  0.13264852E 01  0.10761346E 01  0.23404696E 01  0.15545197E 01  0.49696207E 00
 0.12597352E 01  0.54631045E 00  0.0             0.0             0.0             0.0
 0.0             0.0             0.0             0.0             0.0             0.0
 0.0             0.0             0.0             0.0             0.0             0.0
 0.0             0.0             0.0             0.0             0.0             0.0
 0.0             0.0             0.0             0.0             0.0             0.0
 0.0             0.0             0.0             0.0             0.0             0.0
 0.0             0.0             0.0             0.0             0.0             0.0
 0.0             0.0             0.0             0.0             0.0             0.0
 0.0             0.0             0.0             0.0             0.0             0.0
 0.0             0.0             0.0             0.0             0.0             0.0
 0.0             0.0             0.0             0.0             0.0             0.0
 0.0             0.0             0.0             0.0             0.0             0.0
 0.0             0.0
                     THE  10 B-MATRIX ELEMENTS FOR MODE NO.   2
 0.11999999E-01  0.29999179E-01  0.13499994E-01  0.36999996E-01  0.14999941E-01  0.17999991E-01
 0.33999994E-01  0.29999979E-01  0.23999993E-01  0.49999979E-02
                     THE  10 WJ MATRIX ELEMENTS FOR MODE NO.   2
 0.0             0.50000000E 01  0.0             0.50000000E 01  0.0             0.50000000E 01
 0.0             0.50000000E 01  0.0             0.50000000E 01  0.0             0.50000000E 01
 0.0             0.50000000E 01  0.0             0.50000000E 01  0.0             0.50000000E 01
 0.0             0.50000000E 01
                     THE  10 WJ-PRIME ELEMENTS FOR MODE NO.   2
 0.0             0.0             0.0             0.0             0.0             0.0
 0.0             0.0             0.0             0.0             0.0             0.0
 0.0             0.0             0.0             0.0             0.0             0.0
 0.0             0.0
COL. NO.   2  OF DEL-CP MATRIX
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-0.94977827E 01	0.21794113E 02	-0.11780461E 02	0.31415901E 01	-0.13351763E 02	0.31415920E 01
-0.14529057E 02	0.15707960E 01	-0.15515258E 02	0.15707960E 01	-0.14922559E 02	-0.31415920E 01
-0.13351763E 02	-0.31415920E 01	-0.11780461E 02	-0.31415901E 01	-0.94267723E 01	-0.62831802E 01
-0.31269096E 01	-0.15707960E 02				

COLUMN NO. 2 OF THE AUGM MATRIX

0.17777653E 01	0.23762989E 01	0.18216514E 01	0.25562917E 01	0.19268961E 01	0.22974291E 01
0.11816661E 01	0.26855215E 00	0.12006570E 01	0.18661974E 00	0.11550365E 01	0.45534186E 00
0.55660724E 00	0.35691121E 00	0.62189617E 00	-0.41772609E 00	0.65552916E 00	-0.27691650E 00
0.77540156E-01	-0.40244268E 00	0.11786164E 00	-0.42756679E 00	0.15616266E 00	-0.42775520E 00
0.31155149E 00	0.11004159E 01	0.15694670E 00	0.75876015E 00	0.67509295E 00	0.46076567E 00
0.51660974E 00	0.15625699E [illegible]	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0	0.0	0.0	0.0	0.0
0.0	0.0				

MODE NO. 1

NODE NO.	ROF	X	Y	Z	PRESSURES	
1	0.04333	4.97416	1.50333	0.0	0.52110181E 02	-0.17311566E 02
2	0.41666	5.15541	1.50000	0.0	0.41559756E 02	0.33456975E 02
3	0.75000	6.11250	1.50000	0.0	0.14122194E 02	0.70657166E 02
4	0.04333	4.91750	2.50000	0.0	0.73670322E 02	-0.15443573E 02
5	0.41666	5.54760	2.50000	0.0	0.44376665E 02	0.22811256E 02
6	0.75000	6.41750	2.50000	0.0	0.23170776E 02	0.61676227E 02
7	0.04333	5.13541	3.50000	0.0	0.21624500E 02	-0.96606692E 01
8	0.41666	5.47916	3.50000	0.0	0.16070031E 02	0.22576766E 02
9	0.75000	6.56250	3.50000	0.0	0.16247390E 02	0.49215681E 02
10	0.04333	5.85617	4.50000	0.0	0.24551270E 02	0.13609355E 02
11	0.41666	6.27041	4.50000	0.0	0.12470457E 02	0.25679367E 02
12	0.75000	6.64750	4.50000	0.0	-0.10220767E 01	0.31592103E 02
13	0.12500	9.23518	1.50000	0.0	0.13178317E 01	0.17189429E 03
14	0.62500	9.67148	1.50000	0.0	-0.75672708E 01	0.42366252E 02
15	0.12500	9.55111	2.50000	0.0	0.16227260E 01	0.16793216E 03
16	0.62500	9.76561	2.50000	0.0	0.12514185E 02	0.94567106E 02
17	0.03125	2.25000	0.50000	1.00000	0.13592596E 00	-0.57935696E 00
18	0.15625	3.25000	0.50000	1.00000	0.51850037E 00	0.90000894E 00
19	0.28125	4.25000	0.50000	1.00000	-0.16927041E 00	0.11116711E 01
20	0.40625	5.25000	0.50000	1.00000	-0.52666790E 01	-0.30017366E 01
21	1.53125	6.25000	0.50000	1.00000	0.25550051E 01	-0.45115637E 01
22	0.65625	7.25000	0.50000	1.00000	0.46353912E 01	-0.56202560E 01
23	0.78125	4.25000	0.50000	1.00000	0.16529665E 01	0.66402777E-01
24	0.09363	4.12500	0.50000	1.00000	-0.92692756E 00	-0.16576226E 02
25	0.35313	4.62500	0.50000	1.00000	0.45681696E 01	-0.11931390E 02
26	0.03125	2.25000	1.00000	0.50000	0.52803260E-01	0.11052355E-01
27	0.15625	3.25000	1.00000	0.50000	0.14150536E 00	-0.29169097E 00
28	0.28125	4.25000	1.00000	0.50000	0.40713072E 01	-0.34515967E 01
29	0.40625	5.25000	1.00000	0.50000	0.13778064E 02	0.58673756E 01

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30	0.53125	6.25000	1.00000	0.50000	0.938368480E 01	0.199572795E 02
31	0.65625	7.25000	1.00000	0.50000	0.106067735E 01	0.291302208E 01
32	0.78125	8.25000	1.00000	0.50000	0.296036553E 01	-0.270079978E-01
33	0.89063	9.12500	1.00000	0.50000	0.360745981E 02	0.298435066E 02
34	0.95313	9.62500	1.00000	0.50000	0.904531571E 01	0.340407108E 02
35	0.03125	2.25000	1.00000	-0.50000	-0.528716490E-01	-0.130688511E-01
36	0.15625	3.25000	1.00000	-0.50000	-0.141512046E 00	0.283710186E 00
37	0.28125	4.25000	1.00000	-0.50000	-0.407126716E 01	0.385147766E 01
38	0.40625	5.25000	1.00000	-0.50000	-0.117780821E 02	-0.604735828E 01
39	0.53125	6.25000	1.00000	-0.50000	-0.938370995E 01	-0.199573046E 02
40	0.65625	7.25000	1.00000	-0.50000	-0.106072086E 01	-0.291318809E 01
41	0.78125	8.25000	1.00000	-0.50000	-0.296026711E 01	0.270471616E-01
42	0.89063	9.12500	1.00000	-0.50000	-0.360786490E 02	-0.298436138E 02
43	0.95313	9.62500	1.00000	-0.50000	-0.904521946E 01	-0.340409094E 02
44	0.03125	2.25000	0.50000	-1.00000	-0.133415366E 00	0.571335950E 00
45	0.15625	3.25000	0.50000	-1.00000	-0.558518498E 00	-0.899985731E 00
46	0.28125	4.25000	0.50000	-1.00000	0.549251138E 00	-0.131373504E 01
47	0.40625	5.25000	0.50000	-1.00000	0.520444827E 01	0.300170046E 01
48	0.53125	6.25000	0.50000	-1.00000	-0.255491038E 01	0.453145898E 01
49	0.65625	7.25000	0.50000	-1.00000	-0.463527491E 01	0.662815006E 01
50	0.78125	8.25000	0.50000	-1.00000	-0.165272246E 01	-0.466932778E-01
51	0.89063	9.12500	0.50000	-1.00000	0.926669038E 00	0.145741608E 02
52	0.95313	9.62500	0.50000	-1.00000	-0.956424646E 01	0.119312978E 02

MODE NO 1

STRIP NO.	Y	Z	Y/S	LIFT COEFFICIENT		MOMENT COEFFICIENT	
1	1.5000	0.0	0.3000	31.020737	29.161011	-11.467739	-21.891312
2	2.5000	0.0	0.5000	30.339386	22.614761	-12.608169	-18.526979
3	3.5000	0.0	0.7000	22.899479	20.744095	-8.955248	-15.162906
4	4.5000	0.0	0.9000	11.999836	23.635239	-2.158453	-11.830099
5	1.5000	0.0	0.3000	62.118027	132.190250	-5.877938	-39.599060
6	2.5000	0.0	0.5000	47.383362	126.249636	-14.056464	-34.922958
7	0.5000	1.0000	0.1000	1.526612	-3.715916	-1.248104	2.718618
8	1.0000	0.5000	0.2000	7.248824	7.191329	-4.531127	-5.458472
9	1.0000	-0.5000	0.2000	-7.248796	-7.191366	4.531102	5.458501
10	0.5000	-1.0000	0.1000	-1.526567	3.715967	1.248072	-2.718609

MODE NO 1

BODY NO.	Y	Z	Y/S	LIFT COEFFICIENT		MOMENT COEFFICIENT	
1	0.0	0.0	0.0	0.503440	1.763999	0.789920	-0.897987

CZ =	65.901276	52.920111	CY =	0.000029	-0.000038
CM =	-125.104690	-193.006531	CN =	0.0	0.0
CL(ROLL) =	0.0	0.0			

PRESSURE MODE	DEFLECTION MODE	GENERALIZED FORCES	
1	1	0.662709248E 01	0.396916551E 02
1	2	0.146883858E 02	0.169066278E 02

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MODE NO. 2

BOX NO.	ARC	X	Y	Z	PRESSURES	
1	0.08333	4.47916	1.50000	0.0	0.65967131E 01	0.27866756E 02
2	0.41666	5.39583	1.50000	0.0	-0.15181664E 02	0.21946045E 02
3	0.75000	6.31250	1.50000	0.0	-0.26711624E 02	0.24533294E 02
4	0.08333	4.93750	2.50000	0.0	0.12284677E 02	0.24626727E 02
5	0.41666	5.60759	2.50000	0.0	-0.44638594E 01	0.27295181E 02
6	0.75000	6.43750	2.50000	0.0	-0.21423599E 02	0.26533569E 02
7	0.08333	5.39583	3.50000	0.0	0.16855820E 02	0.20166765F 02
8	0.41666	5.47916	3.50000	0.0	0.19245994E 01	0.26220444E 02
9	0.75000	6.56250	3.50000	0.0	-0.14214491E 02	0.25631546E 02
10	0.08333	5.85417	4.50000	0.0	0.15344870E 02	0.20631256E 02
11	0.41558	6.27083	4.50000	0.0	0.75723006E 00	0.18291714E 02
12	0.75000	6.68750	4.50000	0.0	-0.82287895E 01	0.15148202E 02
13	0.12500	9.21458	1.50000	0.0	0.29727214E 02	0.75863510E 02
14	0.62500	9.67188	1.50000	0.0	-0.21850251E 00	0.30109774E 02
15	0.12500	9.45833	2.50000	0.0	0.52975581E 02	0.76464276E 02
16	0.62500	9.76563	2.50000	0.0	0.71695107E 01	0.29446546E 02
17	0.03125	2.25000	0.50000	1.00000	0.27944680E 00	-0.12776255E 00
18	0.15625	3.25000	0.50000	1.00000	-0.64396896E 00	0.59799648E 00
19	0.28125	4.25000	0.50000	1.00000	-0.25411614E 00	-0.81122059E 00
20	0.40625	5.25000	0.50000	1.00000	0.15974719E 01	-0.20186701E 01
21	0.53125	6.25000	0.50000	1.00000	0.51100197E 01	0.51057337E 00
22	0.65625	7.25000	0.50000	1.00000	0.49713745E 01	0.21952496E 01
23	0.78125	8.25000	0.50000	1.00000	0.16144029E 01	0.25457973E 01
24	0.89063	9.12500	0.50000	1.00000	0.20255299E 01	-0.32607622E 01
25	0.95833	9.62500	0.50000	1.00000	0.49861653F 01	-0.23212470E 01
26	0.03125	2.25000	1.00000	0.50000	0.76187649E-02	0.30037355E-01
27	0.15625	3.25000	1.00000	0.50000	0.15990382E 00	0.15619221E 00
28	0.28125	4.25000	1.00000	0.50000	0.15942110E 01	0.67960464E 01
29	0.40625	5.25000	1.00000	0.50000	-0.26859808E 01	0.82869712E 01
30	0.53125	6.25000	1.00000	0.50000	-0.46071999E 01	0.88263809E 01
31	0.65625	7.25000	1.00000	0.50000	-0.74590876E 00	0.16146367E 01
32	0.78125	8.25000	1.00000	0.50000	0.11605096E 01	0.60665790E 00
33	0.89063	9.12500	1.00000	0.50000	0.10743659E 02	0.14066470E 02
34	0.95833	9.62500	1.00000	0.50000	0.22529766E 01	0.12817769E 02
35	0.03125	2.25000	1.00000	-0.50000	-0.76025501E-02	-0.30034516E-01
36	0.15625	3.25000	1.00000	-0.50000	-0.15993005E 00	-0.15619793E 00
37	0.28125	4.25000	1.00000	-0.50000	-0.10941689E 01	-0.67960516E 01
38	0.40625	5.25000	1.00000	-0.50000	0.26859770E 01	-0.82869836E 01
39	0.53125	6.25000	1.00000	-0.50000	0.66414657E 01	-0.88263246E 01
40	0.65625	7.25000	1.00000	-0.50000	0.74702473E 00	-0.16145709E 01
41	0.78125	8.25000	1.00000	-0.50000	-0.11604919E 01	-0.60655618F 00
42	0.89063	9.12500	1.00000	-0.50000	-0.10791608E 02	-0.14067037E 02
43	0.95833	9.62500	1.00000	-0.50000	-0.22528515E 01	-0.12817727E 02
44	0.03125	2.25000	0.50000	-1.00000	-0.27991045E 00	0.12776605E 00
45	0.15625	3.25000	0.50000	-1.00000	0.64396549E 00	-0.59799999E 00
46	0.28125	4.25000	0.50000	-1.00000	0.25417197E 00	0.81122468E 00
47	0.40625	5.25000	0.50000	-1.00000	-0.15977623E 01	0.20186368E 01
48	0.53125	6.25000	0.50000	-1.00000	-0.51019100E 01	-0.51032275E 00
49	0.65625	7.25000	0.50000	-1.00000	-0.49712782E 01	-0.21952067E 01
50	0.78125	8.25000	0.50000	-1.00000	-0.16193380E 01	-0.25456976E 01
51	0.89063	9.12500	0.50000	-1.00000	-0.20255594E 01	0.32607176E 01
52	0.95833	9.62500	0.50000	-1.00000	-0.49962919E 01	0.23233156E 01

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MODE NO. 2

STRIP NO.	X	Y	Y/S	LIFT COEFFICIENT		MOMENT COEFFICIENT	
1	1.5000	0.0	0.1100	-12.432214	25.175320	8.659061	-10.187670
2	2.5330	0.0	0.5333	-4.600985	26.751031	5.662626	-11.602909
3	3.5000	0.0	0.7000	1.515256	24.036271	2.821109	-10.609795
4	4.5000	0.0	0.9000	2.626340	18.026368	1.525789	-6.900922
5	1.5000	0.0	0.3300	14.754125	52.986548	-1.789663	-14.150756
6	2.5000	0.0	0.5000	10.167522	51.065338	-5.610815	-13.999779
7	0.5000	1.0000	0.1000	2.071996	0.018154	-1.375269	-0.026756
8	1.3330	0.5333	0.2300	-0.155633	9.963908	-0.261782	-2.970565
9	1.3330	-0.5330	0.2333	0.155661	-9.963892	0.261755	2.970549
10	0.5000	-1.0000	0.1000	-2.021951	-0.018136	1.375261	0.026761

MODE NO. 2

BODY NO.	X	Y	Y/S	LIFT COEFFICIENT		MOMENT COEFFICIENT	
1	2.0	0.0	0.0	-1.429580	-0.000000	0.864447	0.189516

CZ = -3.264211 55.230774
CM = 10.027156 -111.647176
CLTAILCT = 0.0 0.0

CY = 0.330040 0.000325
CN = 0.0 0.0

PRESSURE MODE	DEFLECTION MODE	GENERALIZED FORCES	
2	1	0.67429809E 01	0.15979133E 02
2	2	-0.26396241E 01	0.10371367E 02

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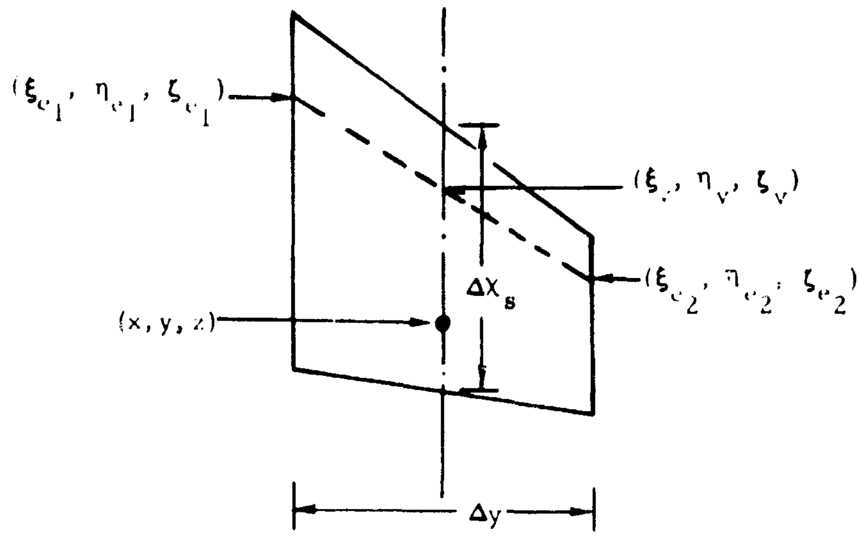
2.3 Blank and Labeled Common Blocks

2.3.1 Blank Common Block

Item No.	Mnemonics	Dimension	Symbol	Source	Description/Equation
1	NCNSM1, NBØX*			PART 1	Total number of boxes (points) on all lifting surfaces (panels) $\sum_{i=1}^{N} (nc_i-1)(ns_i-1)$, where N = NØPAN = number of panels
2	NB			MAIN	Total number of bodies - input
3	NDELT		δ	MAIN	Symmetry flag - input
4	NDATA, N3			MAIN	Data flag - input
5	NØPAN, NP			MAIN	Total number of panels - input
6	IQ		r	initialized in MAIN, used in PART 2	Index of receiving point
7	IR		s		Index of sending point
8	JSPECS, JSP		ϵ	MAIN	Second symmetry flag - input
9	FMACH, M		M	MAIN	Mach Number - input
10	NCARAY	20		PART 1	Array of the number of the chordwise divisions for all panels

* A slash through the O indicates the letter O rather than the number zero.

Item No.	Mnemonics	Dimension	Symbol	Source	Description/Equation
11	NSARAY	20		PART 1	Array of the number of the spanwise divisions for all panels
12	NBARAY	20	nba_i	PART 1	$nba_i = \sum_{j=1}^{i} (nc_j - 1)(ns_j - 1)$, where i = 1, NØPAN
13	ACAP, REFARA		A, S	MAIN	Reference area - input
14	B2, S		b/2, s	MAIN	Reference semispan-input
15	FL, REFCHD		$\bar{c}$, $2b_r$	MAIN	Reference chord - input
16	BETA		β	MAIN	$\beta = \sqrt{1 - M^2}$, where M = Mach Number
17	PI		π	MAIN	π = 3.1415926, built-in constant
18	KR, RFREQ		k_r	MAIN	Reduced frequency - input as RFREQ(20)
19	KRDBR		k_r/b_r	MAIN	Normalized k_r
20	GMA	50	γ_i	PART 1	Array of dihedral angles for all panels in radians; i = 1, NØPAN
21	X	400	x	PART 1	Array of x-coordinates of receiving points (3/4 chord point of box) - see sketch on next page.



Sketch 2.3-1

Item No.	Mnemonics	Dimension	Symbol	Source	Description/Equation
22	Y	400	y	PART 1	Array of y-coordinates of receiving points
23	ZZ	400	z	PART 1	Array of z-coordinates of receiving points
24	Z1	400	ξ_{e1}	PART 1	Array of x-coordinates } of inboard sending points
25	P1	400	η_{e1}	PART 1	Array of y-coordinates } of inboard sending points
26	ZZ1	400	ζ_{e1}	PART 1	Array of z-coordinates } of inboard sending points
27	Z2	400	ξ_{e2}	PART 1	Array of x-coordinates } of outboard sending points
28	P2	400	η_{e2}	PART 1	Array of y-coordinates } of outboard sending points
29	ZZ2	400	ζ_{e2}	PART 1	Array of z-coordinates } of outboard sending points

Item No.	Mnemonics	Dimension	Symbol	Source	Description/Equation
30	EV	400	ξ_v	PART 1	Array of x-coordinates of center-line sending points
31	PV	400	η_v	PART 1	Array of y-coordinates of center-line sending points
32	ZV	400	ζ_v	PART 1	Array of z-coordinates of center-line sending points
33	SDELX	400	Δx_s	PART 1	Array of average chordlengths of all boxes
34	DELY	400	Δy	PART 1	Array of box widths. See sketch above for items no. 21-34.

The Blank Common is used by the following subroutines of the program: MAIN, PART1, GENQ, AUGW and PART2.

2.3.2 Labeled Common Blocks

Common Name	Source	User Subroutines
/BØDY/	PART1	GENQ, AUGW, GENF
/MØDE/	GENQ	AUGW
/DLM/	KERNEL	INCRØ
/NTPS/	MAIN	GENB, GENW, GENQ, PART2, SSLECX, CXSS, AIC, AERØ, FINAL, GENF
/PIGW/	PART1	GENB
/XXZ/	PART1	FINAL, GENF
/XYZ/	PART1	GENQ, AERØ
/YZY/	GENB	AERØ. FINAL

The following is a detailed description of the contents of each labeled common block.

Common Name	Mnemonics	Dimension	Symbol	Source	Description/Equation
BØDY	R0	100	R_{oj}	PART1	Body radius distribution
	R0P	100	R'_{oj}	PART1	x-derivative of body radius distribution
	NBEA	20	nbe_i	PART1	$nbe_i = \sum_{j=1}^{i} (nf_j - 1)$, where nf_j is the number of body endpoints for the j-th body; i = 1, NB

Common Name	Mnemonics	Symbol	Description
MØDE	N8(80)	N8	Flag for spanwise variables
	NARQ(80)	NA	Number of ARQ values for all panels and modes
	LARQ(120, 2)	(N, M)	Array of subscripts of all ARQ's
	ARQ(120)	ARQ	Array of ARQ's
	H(400)	[h]	[h] matrix } input for special cases only
	DH1(400)	[dh/dx]	[dh/dx] matrix } input for special cases only
	DH2(400)	$[d^2h/dx^2]$	$[d^2h/dx^2]$ matrix } input for special cases only
			See Input Data, Sec 2.1.2

Common Name	Mnemonics	Symbol	Source	Description/Equation
DLM	K10	$K_1^{(s)}$	KERNEL	Planar part of the steady contribution to the Kernel
	K20	$K_2^{(s)}$		Nonplanar part of the steady contribution to the Kernel
	K1RT1	$R\ell \bar{K}_1$		$R\ell\ (\Delta K_1)\ T_1$ Unsteady part of Kernel
	K1IT1	$Im\bar{K}_1$		$Im\ (\Delta K_1)\ T_1$ Unsteady part of Kernel
	K2RT2P	$R\ell \bar{K}_2$		$R\ell\ (\Delta K_2)\ T_2^*$ Unsteady part of Kernel
	K2IT2P	$Im\bar{K}_2$		$Im\ (\Delta K_2)\ T_2^*$ Unsteady part of Kernel
	K10T1			$K_1^{(s)}\ T_1$
	K20T2P			$K_2^{(s)}\ T_2^*$
	E2	e^2	INCRØ	e semi-width of sending box

Common Name	Mnemonics	Dimension	Symbol	Source	Description/Equation
NTPS	NTP1 NTP2 NTP3 NTP4 NTP5 NTP6 NTP7 NTP8 NTP9 NTP10			MAIN	Variable names for logical tape units used in program. For present assignment of units see Sec. 2.4 (Logical Tape Units)
P1GW	CT1	20	$\tilde{C}_I$	PART1	Array of chord-lengths for inboard edge of all panels; $\tilde{C}_I = X_2 - X_1$
	CT2	20	$\tilde{C}_\phi$		Array of chord-lengths for outboard edge of all panels; $\tilde{C}_o = X_4 - X_3$
	TS	50	τ_{avg}		$\tau_{avg_i} = \frac{\tau_i + \tau_{i+1}}{2}$, where τ_i is the i-th fractional spanwise division of panel; i = 1, NSTRIP

Common Name	Mnemonics	Dimension	Symbol	Source	Description/Equation
XXZ	XØC	400	x/c	PART1	x-location of load points as a fraction of local chord
	XIJ	50	x_{le}		x-coordinate of leading edge for center of strips
XYZ	YS	50		PART1	y-coordinate of centerline of strip
	DELYS	50			Δy for strip
	ZS	50			z-coordinate of center-line of strip
	DELZS	50			Δz for strip
	FGAMMA	50			Dihedral angle for strip, in radians
	CWIG	50			Average chord length of strip
YXY	X1A*	50		GENB	(Alternative #1 AIC) Elastic axis (ALT. #2) Location of first control point.
	X3A*	50			Location of third control point.
	X5A*	50			Location of rotation axis for control surface
	X7A*	50			Location of rotation axis for tab
	X2A*	50			Location of second control point

* All coordinates given in fractions of local chord

2.4 LOGICAL TAPE UNITS

Tape Number		User Subroutines
Symbol	Present Assignment	
NTP1	1	MAIN, GENQ, PART2, SSLECX, SØLVIT, QUAS, FUTSØL
NTP2	13	MAIN, QUAS, FUTSØL
NTP3	3	MAIN, GENW, GENQ, SSLECX, CXSS, SØLVIT, QUAS, FUTSØL, AIC, FINAL, GENF
NTP4	4	MAIN, GENQ, CXSS, SØLVIT, QUAS, FUTSØL
NTP7	12	AUGW, GENF
NTP8	8	MAIN, GENQ, QUAS, FUTSØL
NTP9	9	MAIN, GENQ, SØLVIT, QUAS, FUTSØL, AIC, AERØ
NTP10	10	MAIN, GENB, GENW, GENQ, SSLECX, CXSS, AIC, FINAL, GENF
LTAPE	11	QUAS, FUTSØL
MTAPE	7	GENQ
NAT	NTP2	QUAS, FUTSØL
RHSTAP	4	QUAS, FUTSØL

Logical tape units 5 and 6 are used throughou the program as the standard READ and WRITE units respectively.

Logical tape units MTAPE, NTP9 and LTAPE can be specified as master tapes. MTAPEcan be used as modal input tape for special cases; see 2.5.6.4 for pertinent information. NTP9 is used for saving the AIC supercolumns when this is desired — see 2.5.19.6. LTAPE contains the quasi-inverse matrix for future solutions of cases with new modes only — see 2.5.17.6.

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2.5 DESCRIPTION OF SUBROUTINES

Program H7WC is operational on the IBM 7094 and 360/65, and the GE 635 computers. The main part of the program controls all the twenty-one subroutines of the program: PART1, GENB, GENW, GENQ, AUGW, TKER, PART2, INCRØ, KERNEL, IDF1, IDF2, SNPDF, SSLECX, CXSS, SØLVIT, QUAS, FUTSØL, AIC, AERØ, FINAL and GENF. The following is a description of each of the subroutines in the order of their use within the program.

2.5.1 MAIN

Functional Description

The MAIN part of the program reads the header card for each data set, the Mach number, the reference area, the reference semi-span and the reference chord as well as the control flags that define the various types of cases. MAIN also reads the array of reduced frequencies, and in case of an AIC-type analysis, additional control data is read, as well as the gust data, if computation of the harmonic gust coefficients is also desired. In case of a modal-type analysis, the control data is read for the modes to be used. Depending on the type of the case, MAIN selects the appropriate subroutines in an overall frequency-loop, except for PART1 and GENB (latter in case of AIC's only), which are independent of the reduced frequency.

The following is a summary of all data items used in MAIN, grouped according to their source. Detailed description of each input data item is given in Sec. 2.1.2. Other data items are described in Sec. 2.3 (Contents of Common) and/or Sec. 2.4 (Logical Tape Units) as indicated below.

Data from Cards

FMACH, ACAP, FL, B2, NDELT, NP, NB, NRF, NCØRE, N1, N2, N3, N4, RFREQ(20), NSTRIP, NB1, NB2, NPR1, NPR2, NPR3, JØBNØ, JØBNØ2, NGUST, JSPECS, NPC, NSV, NBV, NYAW, GZRØ, XZRØ, VEL, WG, LIM(50,3), NMD, NTA, N5, N6, N7, NTP1, NTPM, NMTP, NMTB.

See Sec. 2.1.2 for description.

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Data from Common

NCNSM1, NCARAY(20), NSARAY(20), NBARAY(20), GMA(50), X(400), Y(400), ZZ(400), Z1(400), P1(400), ZZ1(400), Z2(400), P2(400), ZZ2(400), EV(400), PV(400), ZV(400), SDELX(400), DELY(400) – from Blank Common.

YS(50), DELYS(50), ZS(50), DELZS(50), FGAMMA(50), CWIG(50) – from Common /XYZ/.

X1A(50), X3A(50), X5A(50), X7A(50), X2A(50) – from Common /YZY/.

XØC(400), CWIG(400) – from Common /XXZ/.

CT1(20), CT2(20), TS(50) – from Common /P1GW/.

R0(100), R0P(100), NBEA(20) – from Common /BØDY/.

K10, K20, K1RT1, K1IT1, K2RT2P, K2IT2P, K10T1, K10T2P, E2 – from Common /DLM/.

See Sec. 2.3 for details.

Data from Tapes

MNEMØNICS	SYMBØL	TAPE NAME	DESCRIPTION
AUGM(530)	$[A^{ww}]$	NTP1	Matrix of complex downwash factors, read one row at a time. Dimension of matrix is NBØX x NBØX.
WQ(130)	$[W_q]$	NTP3	Matrix of complex polynomial mode right-hand sides, read one row (of length NMD) at a time. Dimension of matrix is NBØX x NMD.
NTPØLD		LTAPE	Identification number of case for which the quasi-inverse of the matrix of downwash factors was saved on LTAPE in a previous run. For special cases only.

See Sec. 2.4 for present assignment of logical tape units.

Data to Common

NB, NDELT, NDATA, NØPAN, IQ, IR, JSPECS, FMACH, ACAP, B2, FL, BETA, PI, KR, KRDBR — to Blank Common.

NTP1, NTP2, NTP3, NTP4, NTP5, NTP6, NTP7, NTP8, NTP9, NTP10 — to Common/NTPS/.

See Sec. 2.3 for details.

Data to Tapes

MNEMØNICS	SYMBØL	TAPE NAME	DESCRIPTION
NTP1		LTAPE	Identification number of current case, used to identify the quasi-inverse that is to be saved on LTAPE. For special cases only, when the input data N5 is set to 1.
AUGM(530)	$[A^{ww} \vdots W_q]$	NTP4	Augmented downwash matrix: matrix of downwash factors augmented by the matrix of polynomial mode right hand sides written one row (of length NBOX + NMD) at a time. Dimension of matrix is NBØX x (NBØX + NMD).

2.5.2 SUBROUTINE PART1 (JCUM, CØEFP, CØEFB, YIN, ZIN)

Functional Description

Subroutine PART1 reads the geometry input of the idealized aircraft, the desired number of spanwise and chordwise divisions per panel, and the fractional location of the division lines. The panels are subdivided into boxes, and arrays of coordinates are generated for all boxes of all panels. In the case when body interference is also desired, PART1 reads the geometry data for all bodies and generates the necessary body-coordinate arrays. The computed arrays are made available for subsequent calculations through the Blank Common block placed in the

appropriate user subroutines. Additional items of computed geometry are transmitted to MAIN via the argument list of PART1, and to several other subroutines via the Labeled Common blocks /P1GW/, /XXZ/ and /XYZ/.

Data from Cards

XCAP(4), YCAP(2), ZCAP(2), NC, NS, CØEFP(20), TH(50), TAU(50), ZSC, YSC, NF, NZ, NY, CØEFB(20), F(50), RAD(50).

See Sec. 2.1.2 for details.

Data from Common

NB, NDELT, NDATA, NØPAN, IQ, IR, JSPECS, FMACH, ACAP, B2, FL, BETA, PI, KR, KRDBR – from Blank Common Block.

See Sec. 2.3 for details.

Data from Tapes

None

Data to Common

NCNSM1, NCARAY(20), NSARAY(20), NBARAY(20), GMA(50), X(400), Y(400), ZZ(400), Z1(400), P1(400), ZZ1(400), Z2(400), P2(400), ZZ2(400), EV(400), PV(400), ZV(400), SDELX(400), DELY(400) – to Blank Common block.

YS(50), DELYS(50), ZS(50), DELZS(50), FGAMMA(50), CWIG(50) – to Common /XYZ/.

XØC(400), XIJ(50) – to Common /XXZ/.

CT1(20), CT2(20), TS(50) – to Common /P1GW/.

R0(100), R0P(100), NBEA(20), BGMA(20) – to Common /BØDY/.

Data to Tapes

None

Data in Argument List

MNEMONICS	SYMBOL	DESCRIPTION/EQUATION
JCUM, NSTRIP		Number of strips on all panels
CØEFP(20)		Array of panel-coefficients — input
CØEFB(20)		Array of body-coefficients — input
YIN(20)		Array of y-coordinates of inboard edge of panels
ZIN(20)		Array of z-coordinates of inboard edge of panels

2.5.3 SUBROUTINE GENB (EV, SDELX, DELY, X, NSTRIP, BETA, IMX, NPC, NP, NSARAY, LIM)

Functional Description

Subroutine GENB reads the AIC-type mode flags for all panels of the lifting surfaces. It also reads the array of fractional chord lengths for the various control points and hinge line locations at the inboard edge and at the outboard edge of each panel. Subroutine GENB computes arrays of coordinates to be used in GENB and GENW and saves them on logical tape unit NTP10. Depending on the setting of the flag NPC (input data), subroutine GENB computes the integration matrix [B] according to Alternative 1 (NPC = 0) or Alternative 2 (NPC = 1). (See Eq. 2.5-12, Pt I, Vol I.) The [B] matrix is saved on logical tape unit NTP10 in a partitioned format, and is used in subroutine AIC for the computation of the AIC supercolumns * and harmonic gust coefficient columns, when latter is also desired.

Data from Cards

NØP(20), IS(20, 7), XHI (20, 7), XHØ (20, 7).

---

* A supercolumn of a matrix is a matrix-column whose elements are the columns of the original matrix taken in order; i.e., the second column is below the first, the third column is below the second, etc. A square matrix of order N becomes a supercolumn matrix of size $N^2 \times 1$.

See Sec. 2.1.2 for details.

Data from Common

NTP1, NTP2, NTP3, NTP4, NTP5, NTP6, NTP7, NTP8, NTP9, NTP10 – from Common /NTPS/.

CT1(20), CT2(20), TS(50) – from Common /PIGW/.

Data from Tapes

None

Data to Common

X1A(50), X3A(50), X5A(50), X7A(50), X2A(50) – to Common /YZY/.

Data to Tapes

MNEMONICS	SYMBOL	TAPE NAME	DESCRIPTION
NSTRIP		NTP10	Total number of strips on all lifting surfaces (panels)– input data.
NSIZB(j, 1)			Number of AIC-modes for strip j
NSIZB(j, 2)			Number of boxes in strip j
NSIZB(50, 2)			
LIM(50, 3)			Aerodynamic box limits – input
XISLCT(50, 10)			AIC-type modal flags – input
XH(50, 7)			Array of AIC-type reference coordinates
X(400)	x		See Blank Common
SDELX(400)	Δx		See Blank Common
B(30, 10)	[B]		Integration matrix for the Aerodynamic Influence Coefficients (AIC's).

Data in Argument List

MNEMONICS	SYMBOL	DESCRIPTION
EV(400)	η_v	See Blank Common
SDELX(400)	Δx_s	See Blank Common
DELY(400)	Δy	See Blank Common
X(400)	x	
NSTRIP		Total number of strips — input
BETA	β	See Blank Common
IMX		Maximum number of rigid body modes for case
NPC		Camber flag — input
NP, NØPAN		Number of panels — input
NSARAY(20)		Array of the number of spanwise divisions (NS) for all panels
LIM(50, 3)		Aerodynamic box limits for all strips — input

2.5.4 SUBROUTINE GENW (KRDBR, NCSFTØ, NPC, NGUST, WG, GZRØ, XZRØ)

Functional Description

Subroutine GENW computes the AIC-type substantial derivative matrix, [W] described in Sec. 2.5.1*. Depending on the setting of the flag NPC (input data), the [W] matrix is computed according to Alternative 1 (NPC = 0) or Alternative 2 (NPC = 1). The matrix is saved for subsequent calculations on logical tape unit NTP3 in a partitioned format, described in Sec. 2.5.2*. In the case when computation of the harmonic gust coefficients is also desired, subroutine GENW also computes the gust downwash vector, and saves it on logical tape unit NTP3.

*See Part I, Vol I

Subroutines GENB and GENW are used only if an AIC-type analysis is desired.

Data from Cards

None

Data from Common

YS(50), DELYS(50), ZS(50), DELZS(50), FGAMMA(50), CWIG(50) – from Common /XYZ/ .

Contents of Common /NTPS/.

Data from Tapes

NSTRIP, NSIZB(50, 2), LIM(50, 3), XISLCT(50, 10), XH(50, 7), X(400), SDELX(400) – from NTP10, written in GENB.

Data to Common

None

Data to Tapes

MNEMONICS	SYMBOL	TAPE NAME	DESCRIPTION
GRHS(400)	$\{W_{gust}\}$	NTP3	Gust right hand sides (downwash vector) $W_{gust_i} = \cos(\Gamma_g - \gamma_i) \cdot \exp(-i\frac{k_r}{b_r}(x_i - x_o))$, where Γ_g = gust field declination from the vertical – input γ_i = dihedral angle of lifting surface at point i k_r = reduced frequency – input b_r reference semichord x_i = x-coordinate of downwash point i x_o gust reference coordinate – input

MNEMONICS	SYMBOL	TAPE NAME	DESCRIPTION
W(30, 10)	$[W_{AIC}]$	NTP3	Partitioned AIC-type downwash matrix. See Sec. 2.5.2*.

Data in Argument List

MNEMØNICS	SYMBØL	DESCRIPTION	
KRDBR		k_r/b_r	
NCSFTØ, NBØX		Total number of boxes on all panels	
NPC		Camber flag	input
NGUST		Gust flag	input
WG	w_g	Harmonic gust amplitude	input
GZRØ	Γ_g	Gust angle of declination	input
XZRØ	x_o	Gust reference coordinate	input

*See Part I, Vol I

2.5.5 SUBRØUTINE GENQ (N4, N5, N6, NRF, JRF, NBE, NMD, NMTP, NMTB, NCØRE, KDØ2, YIN, ZIN, CØEFP, CØEFB)

Functional Description

Subroutine GENQ generates the normalwash boundary condition for all lifting surface elements. It also generates the integration matrix used to obtain the generalized forces. The normalwash w_{ri} (r ranges over all lifting surface box receiving points while i ranges over all modes) is written on tape row by row (r = 1, i = 1, 2, . . . , NMD, r = 2, i = 1, 2, . . . , NMD, etc.) to facilitate its use with subroutine SØLVIT. However, if the number of modes times the number of unknowns (NCØRE) exceeds the size of the working array in SØLVIT, and/or if the input flag N5 is set to 1, the W matrix is written on tape in column order, preceded by the number of modes (NMD), ready for use by subroutines QUAS and FUTSØL. The integration matrix B_{ri} is written on tape in column order.

The formula for w used is given by equations 2.3-2*and 2.3-3*for cases without bodies, and by equation 2.2-13*for body cases; the contribution of the body effect to the normalwash, w_{B_r}, is computed in subroutine AUGW, which is called from subroutine GENQ for body cases only. w_{B_r} is computed one column at a time, and is transmitted to GENQ via the argument list of subroutine AUGW. The total normalwash matrix for body cases, $(w_r - w_{B_r})_i$, is then written on tape in either row, or column order depending on the size (NCØRE) of the problem and/or on the setting of the input flag N5.

Data from Cards

NR, NQ, NARQ(80), N8(80), LARQ(120, 2) and ARQ(120) for standard polynomial cases (N6 = 0).

When modes are input from cards (N6 = 2), the data input from cards are:

NBØX, BQ(400), H(400) and DH1(400).

*See Part I, Vol I

Data from Common

Contents of Blank Common and the labeled common blocks /NTPS/ and /BODY/.

Data from Tapes

N6 = 0 cases:

None, if NRF = 1. If NRF > 1 and JRF > 1 (see Sec. 2.5.5.), the following data items are read from tape NTP10:
BQ(400), N8(80), NARQ(80), LARQ(120, 2), and ARQ(120).

N6 = 1 cases: modes are input from tape as follows.

NBØX, BQ(400), H(400) and DH1(400) from tape MTAPE; present assignment is NTP8 = 8.

Data to Common

N8(80), NARQ(80), LARQ(120, 2), and ARQ(120), H(400), DH1(400) and DH2(400) to common /MØDE/.

Data to Tapes

MNEMONICS	SYMBOL	TAPE	DESCRIPTION
BQ(400)	$[B_q]$	NTP10	Integration matrix for modal analysis written in column order. Dimension of matrix is NTØTxNMD, where NTØT is the total number of elements (e.g. NTØT = NBØX, if there are no body elements, and NTØT = NBØX + NBE otherwise, where NBE = total number of body elements).
NMD	NM	NTP4	Number of modes; written only if N5 = 1 and/or NCØRE ≥ 4000.

MNEMONICS	SYMBOL	TAPE	DESCRIPTION
WQ(400)	$[W_q]$	NTPW	Matrix of polynomial mode right hand sides (normalwash). Dimension of matrix is NBØX x NMD. The matrix $[W_q]$ is written on tape in row order, unless N5 = 1, and/or NCØRE ≥ 4000; in latter case, $[W_q]$ is written on tape in column order. Note that NTPW = NTP3 in case of row order, and NTPW = NTP4 in case of column order.
BQ(400)	$[B_q]$		The following items are written on tape only if more than one reduced frequency is prescribed for the case (NRF>1).
N8(80)		NTPB	See Input Data, 2.1.2
NARQ(80)	NA		
LARQ(120, 2)	(N, M)		Note that NTPB = NTP2 for cases without bodies, and NTPB = 10 for body cases.
ARQ(120)	ARQ		

Data in Argument List

MNEMONICS	SYMBOL	DESCRIPTION
N4		Print flag - input
N5		Flag to save quasi-inverse - input
N6		Modal input data flag - input
NRF		Number of reduced frequencies for case - input
JRF		Sequence number of reduced frequency currently used in the frequency do-loop

MNEMONICS	SYMBOL	DESCRIPTION
NBE		Total number of body elements
NMD	NM	Number of modes - input
NMTP	MP	Total number of ARQ - values for all panels and modes - input
NMTB	MB	Total number of ARQ - values for all bodies and modes - input
NCØRE		Total number of unknowns for case - input
KDØ2	KD/2	4000 - built in constant (MAIN)
YIN(20)	Y1	Array of y-coordinates of inboard edge of panels
ZIN(20)	Z1	Array of z-coordinates of inboard edge of panels.
CØEFP(20)	coef	Array of modal coefficients for panels (See Eq.(2. 3-3))
CØEFB(20)	coef	Array of modal coefficients for bodies (See Eq.(2. 3-3))

2. 5. 6 SUBRØUTINE AUGW (NMD, NBØX, NBE, NMTB, N4, N6, NRF, JRF, J, CØEFB, ASUM)

Functional Description

This subroutine gives the incremental normalwash, w_{B_r}, at all lifting surface boxes, r, due to the axial singularities on all bodies, B. Slender body theory is used to obtain the strength of the axial singularities. The formulae used in this subroutine are given by Equations (2. 2-8) through (2. 2-10)* The incremental normalwash values, w_{B_r}, are transmitted to subroutine GENQ via the argument list under the mnemonic name ASUM one column (for one mode) at a time. This subroutine also computes the integration matrix of all body elements for the calculation of the generalized forces for body cases.

Subroutine AUGW is bypassed for data without body elements.

*See Part I, Vol I

Data from Cards

None for the special case when N6 = 1 (data input from tape MTAPE).

For standard polynomial cases (N6 = 0) data input from cards is same as for subroutine GENQ, except that data is now read for body elements instead of panel boxes.

Data from Common

Contents of Blank Common, and the labeled common blocks /BØDY/ and /MØDE/.

Data from Tapes

None for standard polynomial mode cases. For the special case when the modal data flag N6 = 1, the following data items are input from tape:

MNEMONICS	SYMBOL	TAPE	DESCRIPTION
NBE			Number of body elements
BB(80)	$[B_q]$	NTP8	Integration matrix for the body elements
H(400)	$[h]$		$[h]$ matrix
DH1 (400)	$[dh/dx]$		$[dh/dx]$ matrix
DH2(400)	$[d^2h/dx^2]$		$[d^2h/dx^2]$ matrix
			The above three matrices are read in column order. Dimension of matrices is NBE x NMD.

Data to Common

None

Data to Tapes

MNEMØNICS	SYMBØL	TAPE	DESCRIPTION
BB(80)	B_q	NTP8	One column of the integration matrix for body elements written on tape for one mode; length of column is NBE. The following items are written on tape only if more than one reduced frequency is prescribed for case (NRF > 1)
N8(80)	N8	NTPB	See Input Data 2.1.2
NARQ(80)	NA		
LARQ(120, 2)	(N, M)		
ARQ(120, 2)	ARQ		

Data in Argument List

MNEMØNICS	SYMBØL	DESCRIPTIØN
NMD	NM	Number of modes input
NBØX		Total number of boxes on all lifting surfaces
NBE		Total number of body elements
NMTB	MB	Total number of ARQ values for all bodies and modes - input

MNEMONICS	SYMBOL	DESCRIPTION	
N4		Print flag for writing the $[AP^z]$, $[AP^y]$ matrices	input
N6		Modal input flag	input
NRF		Number of reduced frequencies for case	input
JRF		Sequence number of current frequency in the frequency do-loop	
J		Sequence number of current mode in modal do-loop	
CØEFB(20)	coef	Array of scale factors for body deflection modes.	
ASUM(400)		Incremental [W] due to body interference	

2.5.7 SUBRØUTINE TKER (X0, Y0, Z0, KR, BR, GAMS, GAMSIG, KKR, KKI, FMACH)

Functional Description

Subroutine TKER evaluates the total unsteady kernel for one receiving-point/sending-point combination for body cases only. (See Eq. A. 5.)* Subroutine TKER is essentially the same as subroutine KERNEL, except that the total, rather than the incremental oscillatory kernel is computed here, and that the planar and nonplanar parts of the kernel are not separated. Subroutine TKER is called from subroutine AUGW; it is bypassed in the case when the input data contains no bodies.

Subroutine TKER uses no card-, tape-, or common-data input or output; data transmission to and from TKER is done through its argument list.

*See Part I, Vol I

Data in Argument List

MNEMONICS	SYMBOL	DESCRIPTION
X0	x_o	$x_i - \xi_j$ } See Blank Common
Y0	y_o	$y_i - \eta_j$ } See Blank Common
Z0	z_o	$z_i - \zeta_j$ } See Blank Common
KR	k_r	Reduced frequency
BR	b_r	Reference semi-chord
GAMS	γ_s	Dihedral angle of sending point j
GAMSIG	γ_r	Dihedral angle of receiving point i
FMACH, M	M	Mach Number
E2		e^2, where e is semi-width of sending box
KKR		Real part of total (steady + unsteady) kernel
KKI		Imaginary part of total kernel

2.5.8 SUBRØUTINE PART2 (NYAW, NBV)

Functional Description

Subroutine PART2 is used for the calculation of the matrix of downwash factors, [D]. (See Eq. 2.1-14.*) It prepares the arguments to subroutines SNPDF and INCRØ, which do the actual computation of the downwash factor elements, and calls these in a do-loop for all boxes of all lifting surfaces. The steady part of the downwash factor elements is computed in subroutine SNPDF, and the incremental oscillatory part in subroutine INCRØ; the call to INCRØ is bypassed for steady cases ($k_r = 0.0$). Subroutine PART 2 also accounts for the effect of the (two) symmetry plane(s).

Data from Cards

None

*See Part I, Vol I

Data from Common

Contents of Blank Common, Common /NTPS/, and Common /DLM/.

Data from Tapes

None

Data to Common

None

Data to Tapes

MNEMONICS	SYMBOL	TAPE	DESCRIPTION
AWW(400) AWWI(400)	$[A^{ww}]$, [D]	NTP1	Matrix of downwash factors written on tape in row order. Dimension of matrix is NBØX x NBØX. The real parts of the matrix elements are called AWW in the program, and the imaginary parts are called AWWI.

Data in Argument List

NYAW – yaw flag

NBV – number of boxes on vertical panels (fin) of T-tail case. } input in MAIN

2.5.9 SUBRØUTINE INCRØ (AX, AY, AZ, AX1, AY1, AZ1, AX2, AY2, AZ2, GAMS, GAMSIG, LHS, IR, IØ, NBXS, NCPNB, NDBLE, NBV, DELR, DELT, FL, BETA, SDELX, DELY, KR)

Functional Description

Subroutine INCRØ prepares the argument for the subroutines KERNEL, IDF1 and IDF2. It calls subroutine KERNEL to compute the

incremental oscillatory part of the kernel, K, for each receiving-sending box combination at the three points of the bound vortex segment: at the center (K_c), at the inboard point (K_i) and at the outboard point (K_o). Since even a relatively small case requires many kernel computations (e.g., a wing with 100 boxes, in symmetry, requires 100x300x2 = 60,000 kernel values), extra programming effort was made to save on computing time. Neighboring strips within a wing panel have a common kernel on the common boundary; this fact is utilized in INCRØ so that the computing time of the kernels is reduced by about 30 percent.

After the triplet of kernels, (K_c, K_i, K_o), is obtained for one receiving-sending box combination, subroutine INCRØ computes the coefficients of the parabolas for the numerical integrations done in two parts. The planar part of the integration is done in subroutine IDF1, and the nonplanar part in IDF2.

Subroutine INCRØ uses no card-, or tape input or output; transmission of data is done through its argument list and the labeled common /DLM/.

Data in Argument List

MNEMONICS	SYMBOL	DESCRIPTION/EQUATION	
AX	x_o	$x - \xi_v$	See Sec. 2.3.1 (Blank Common)
AY	y_o	$y - \eta_v$	
AZ	z_o	$z - \zeta_v$	
AX1		$x - \xi_{e1}$	
AY1		$y - \eta_{e1}$	
AZ1		$z - \zeta_{e1}$	
AX2		$x - \xi_{e2}$	
AY2		$y - \eta_{e2}$	
AZ2		$z - \zeta_{e2}$	

MNEMONICS	SYMBOL	DESCRIPTION/EQUATION
GAMS	γ_r	Dihedral angle of receiving point i
GAMSIG	γ_s	Dihedral angle of sending point j
LHS		Flag; 0 when effect of right wing is computed, 1 for left-wing
IR	j	Index of sending point
IØ		An index running from 1 through NCM1, where NCM1 is the number of chordwise boxes of the strip in which the sending point lies.
NBXS		The number of boxes on the wing panel in which the sending point lies + the total number of boxes of the preceding panels.
NCPNB		The number of boxes in the first strip of the panel in which the sending point lies + the total number of boxes of the preceding panels.
NDBLE, JSPECS, JSP	ϵ	Second symmetry flag - input
NBV		Total number of boxes on vertical panels of T-tail cases - input
DELR		Real part of the incremental oscillatory downwash factor
DELI		Imaginary part of the incremental oscillatory downwash factor
FL, REFCHD	$\bar{c}$	Reference chord - input
BETA	β	$\sqrt{1 - M^2}$
SDELX	Δx_s	Average box-chord of sending box
DELY		2e, box width of sending point
KR	k_r	Reduced frequency

2.5.10 SUBRØUTINE KERNEL (X0, Y0, Z0, KR, BR, GAMS, GAMSIG, EPS, T1, T2, M)

Functional Description

Subroutine KERNEL evaluates the modified incremental oscillatory kernel, $\bar{K}$, for one receiving-sending point combination at a time. The planar and nonplanar parts of the kernel are evaluated separately and are returned to the calling program, subroutine INCRØ, via the labeled common /DLM/. (Evaluates right hand side of Eq. (2.1-13).*)

Subroutine KERNEL uses no card or tape input or output; transmission of data is done through the argument list and the labeled common /DLM/.

Data in Argument List

MNEMONICS	SYMBOL	DESCRIPTION/EQUATION	
X0	x_o	AX for center AX1 for inboard edge AX2 for outboard edge	of sending box; see 2.5.9
Y0	y_o	AY for center AY1 for inboard edge AY2 for outboard edge	
Z0	z_o	AZ for center AZ1 for inboard edge AZ2 for outboard edge	
KR	k_r	Reduced frequency	
BR	$b_r, \bar{c}/2$	Reference semichord	
GAMS	γ_r	see 2.5.9	
GAMSIG	γ_s		

*See Part I, Vol I

MNEMONICS	SYMBOL	DESCRIPTION/EQUATION
EPS	ϵ	$\epsilon = 0.00001$; built in constant from INCRØ
T1	T_1	$T_1 = \cos(\gamma_r - \gamma_s)$
T2	T_2	$T_2 = [z_o \cos\gamma_r - y_o \sin\gamma_r)(z_o \cos\gamma_s - y_o \sin\gamma_s)]/r^2$
M, FMACH	M	Mach number

2.5.11 SUBRØUTINE IDF1(EE, E2, AT2, ETA01, ZET01, ARE, AIM, BRE, BIM, CRE, CIM, R1SQX, XIIJR, XIIJI)

Functional Description

Subroutine IDF1 performs the integration of the planar parts of the incremental oscillatory kernels; see Eq. B. 9.* The result of the integration is the complex number (XIIJR, XIIJI), returned to subroutine INCRØ via the argument list of IDF1.

Subroutine IDF1 uses no card-, tape- or common input or output; data transmission to and from IDF1 is done through its argument list.

Data in Argument List

MNEMONICS	SYMBOL	DESCRIPTION
EE	$e, \Delta y_s/2$	Semiwidth of sending box j
E2	e^2	
AT2	$\lvert T2 \rvert$	See 2.5.10
ETA01	$\bar{y}$	$y_o \cos\gamma_r + z_o \sin\gamma_r$
ZET01	$\bar{z}$	$z_o \cos\gamma_r - y_o \sin\gamma_r$

*See Part I, Vol I

MNEMONICS	SYMBOL	DESCRIPTION
ARE	$Re(A_1)$	Coefficients of the parabola for planar part of kernel-integration
AIM	$Im(A_1)$	
BRE	$Re(B_1)$	
BIM	$Im(B_1)$	
CRE	$Re(C_1)$	
CIM	$Im(C_1)$	
RISQX	r^2	$\bar{y}^2 + \bar{z}^2$
XIIJR		Real part of integral (planar contribution)
XIIJI		Imaginary part of integral (planar contribution)

2.5.12 SUBRØUTINE IDF2 (EE, E2, AT2, ETA01, ZET01, A2R, A2I, B2R, B2I, C2R, C2I, RISQX, DIIJR, DIIJI)

Functional Description

Subroutine IDF2 performs the integration of the nonplanar parts of the incremental oscillatory kernel; see Eqs. (B.15) and (B.16).* The result of the integration is the complex number (DIIJR, DIIJJ), returned to subroutine INCRØ through the argument list of IDF2.

Subroutine IDF2 uses no card , tape or common input or output; data transmission to and from IDF2 is done through its argument list.

*See Part I, Vol I

Data in Argument List

MNEMONICS	SYMBOL	DESCRIPTION
EE	e	
E2	e^2	
AT2	$\lvert T_2 \rvert$	See 2.5.11
ETA01	$\bar{y}$	
ZET01	$\bar{z}$	
A2R	$Re(A_2)$	
A2I	$Im(A_2)$	Coefficients of the parabola for nonplanar part of kernel integration
B2R	$Re(B_2)$	
B2I	$Im(B_2)$	
C2R	$Re(C_2)$	
C2I	$Im(C_2)$	
R1SQX		See 2.5.11
DIIJR		Real part of integral — nonplanar contribution
DIIJI		Imaginary part of integral — nonplanar contribution

2.5.13 SUBRØUTINE SNPDF (SL, CL, TL, SGS, CGS, SGR, CGR, X0, Y0, Z0, EE, DIJ, BETA, CV)

Functional Description

Subroutine SNPDF computes the steady downwash factors for one receiving-sending box combination at a time. The result, DIJ, is returned to PART2 via its argument list. (See Eq. C.35b, Part I, Vol I.)

Subroutine SNPDF uses no card, tape, or common data input or output; data transmission to and from SNPDF is done through its argument list.

Data in Argument List

MNEMONICS	SYMBOL	DESCRIPTION
SL		sin Λ, where Λ is the sweep angle of the 1/4-chord line of sending box [sweep angle of bound vortex] modified by Prandtl-Glauert rule.
CL		cos Λ
TL		tan Λ
SGS		$\sin \gamma_s$
CGS		$\cos \gamma_s$
SGR		$\sin \gamma_r$
CGR		$\cos \gamma_r$
X0		See 2.5.10
Y0		
Z0		
EE	e	Semi-width of sending box
DIJ		Steady contribution to downwash factor
BETA	β	$\sqrt{1 - M^2}$
CV	$c_{avg}, \Delta X_s$	Δx, average chord length of sending box

2.5.14 SUBRØUTINE SSLECX (NCNSM1, MD, NGUST)

Functional Description

Subroutine SSLECX is used with AIC-type data, and only if NCØRE < 4000. It reads the matrix of downwash factors [D] from tape NTP1 one row at a time, and augments it with the AIC-type downwash matrix $[W]_{AIC}$ read from tape NTP3. For gust cases, when NGUST $\neq$ 0, subroutine SSLECX also reads the gust downwash vector from tape NTP3. The augmented matrix $[D \mid W]$ is saved on tape NTP4 in row order, ready to be used by subroutine SØLVIT to obtain the solutions to the system of simultaneous linear equations represented by the matrix $[D \mid W]$.

Data from Cards

None

Data from Common

Contents of Common /NTPS/.

Data from Tapes

MNEMONICS	SYMBOL	TAPE	DESCRIPTION
NSTRIP			
NSIZB(50, 2)		NTP10	See 2.5.3
LIM(50, 3)			
AUGM(530)	[A]	NTP1	Matrix of downwash factors written on tape in row order in subroutine PART2. Dimension of matrix is NBØXxNBØX.
GUST(400)	$\{W_{gust}\}$	NTP3	Gust downwash vector (See 2.5.4)
W(30, 10)	$[W]_{AIC}$	NTP3	AIC type downwash (normalwash). (See 2.5.4)

Data to Common

None

Data to Tapes

MNEMONICS	SYMBOL	TAPE	DESCRIPTION
AUGM(530)	$[A \vdots W]$	NTP4	Augmented downwash factor matrix

Data in Argument List

MNEMONICS	SYMBOL	DESCRIPTION
NCNSM1	n	Total number of boxes on all lifting surfaces (panels)
MD	m	Total number of AIC-type right-hand sides $m = \sum_{j=1}^{NSTRIP} XISLCT_{jmax}$ where NSTRIP = total number of strips on all lifting surfaces, and $XISLCT_{jmax}$ = the number of elastic modes for j-th strip - whenever NGUST = 0. When NGUST ≠ 0 $m = \sum_{j=1}^{NSTRIP} XISLCT_{jmax} + 1.$
NGUST		Gust flag - input

2.5.15 SUBRØUTINE CXSS (NCNSM1, MD, NGUST)

Functional Description

Subroutine CXSS is used with AIC-type data, and only if NCØRE ≥ 4000, and/or N5 = 1. It reads the AIC-type downwash matrix, $[W]_{AIC}$, from tape NTP3 and forms columns of right-hand sides. When NGUST $\neq 0$, subroutine CXSS also reads the gust downwash vector from tape NTP3; this becomes the last column of right hand sides. These are saved on tape NTP4 preceded by the number of right hand sides for the case, ready to be used by subroutine QUAS and FUTSØL to obtain the solutions.

Data from Cards

None

Data from Common

Contents of Common /NTPS/.

Data from Tapes

MNEMONICS	SYMBOL	TAPE	DESCRIPTION
NSTRIP			See 2.5.3
NSIZB(50, 2)		NTP10	See 2.5.3
LIM(50, 3)			See 2.5.3
GUST(400)	$\{W_g\}$	NTP3	Gust downwash vector (see 2.5.4)
W(30, 10)	$[W]_{AIC}$	NTP3	Partitioned matrix of AIC-type downwash (normalwash) (see 2.5.4)

Data to Common

None

Data to Tapes

MNEMONICS	SYMBOL	TAPE	DESCRIPTION
NMD	m	NTP4	Number of AIC-type right hand sides (elastic modes), including the gust right hand side whenever NGUST $\neq 0$
WX(400)		NTP4	Matrix of AIC-type right hand sides written in column order. Dimensions of matrix is NBØX x NMD

Data in Argument List

Same as in 2.5.14

2.5.16 SUBRØUTINE SØLVIT (ND, MD, KD, NI, NM, NØ, NW, NPR1)

Functional Description

Subroutine SØLVIT is used for cases with NCØRE < 4000, and/or N5 = 0. It solves the system of simultaneous linear equations represented by the augmented matrix [D ¦ W], written on tape NTP4. The solutions are saved on tape NTP3 in column order; the data on the input tape, NTP4, is not preserved.

Data from Cards

None

Data from Common

None

Data from Tapes

AUGM(530), the augmented downwash factor matrix from tape NTP4 - see 2.5.1 or 2.5.14.

Data to Common

None

Data to Tapes

MNEMONICS	SYMBOL	TAPE	DESCRIPTION
A(4000)		NTP3	Solution matrix written in column order; dimension of matrix is NDxMD, where ND = NBØX, and MD = NMD.

Note that subroutine SØLVIT uses a single complex work array, A(4000), for all tape input and output variables.

Data in Argument List

MNEMONICS	SYMBOL	DESCRIPTION
ND, NCNSM1, NBØX	n	Total number of boxes on all lifting surfaces (panels) = size of the square matrix $[A^{ww}] = [D]$ = matrix of downwash factors.
MD	m	Total number of right hand sides in the system of simultaneous linear equations solved in subroutine SØLVIT.
KD		Working array size (real-variable dimension); presently set to 8000
NI		NTP4; tape number assigned to tape containing all rows of the augmented matrix $[A^{ww} \mid W]$ - see 2.5.1 or 2.5.14
NM		NTP1; tape number, used as scratch unit
NØ		NTP9; tape number, used as scratch unit
NW		NTP3; tape number assigned to tape containing all solutions of the system of simultaneous linear equations
NPR1		Print flag for solutions - input

For present assignment of tape units see 2.4.

2.5.17 SUBRØUTINE QUAS (ND, MD, KD, NI, MM, NØ, NAT, NW, LTAPE, RHSTAP, NPRI)

Functional Description

Subroutine QUAS is used in conjunction with subroutine FUTSØL for cases with NCØRE ≥ 4000, and/or N5 = 1. It reads the matrix of downwash factors, [D] from tape NTP1 in row order, and as many columns of right hand sides (m, say), from tape RHSTAP, as the dimension of the work area in QUAS (3700 complex words) will permit. Subroutine QUAS computes the so called quasi-inverse of the matrix [D] and saves it on tape LTAPE; it also computes the solutions for the m right hand sides and saves these on tape NTP3.

Data from Cards

None

Data from Common

None

Data from Tapes

MNEMONICS	SYMBOL	TAPE	DESCRIPTION
A(3700)	[D], $[A^{ww}]$	NTP1	Matrix of downwash factors; see 2.5.8
NMD		NTP4	Total number of modes for case
A(3700)	[W]	NTP4	Matrix of right hand sides; see 2.5.5 or 2.5.15

Data to Common

None

Data to Tapes

MNEMONICS	SYMBOL	TAPE	DESCRIPTION
A(3700)		LTAPE	Quasi-inverse matrix of [D]. Master tape has to be specified to preserve quasi-inverse for future analysis; otherwise tape is considered a scratch unit.
A(3700)		NTP3	Solution matrix; dimension NBØX x n, where n is the number of right hand sides for which solutions were obtained.

Note that Subroutine QUAS uses a single complex work array, A(3700) for all input and output variables.

Data in Argument List

MNEMONICS	SYMBOL	DESCRIPTION
ND, NCNSM1, NBØX	n	Total number of boxes on all lifting surfaces
MD	m	On output MD = n = the number of right hand sides for which solutions were obtained
KD		Working array size (complex variable dimension); presently set to 3700.
NI		NTP1; tape number assigned to tape containing all rows of matrix $[A^{ww}]$ (matrix of downwash factors)
MM		NTP8 } tape numbers for scratch units
NØ		NTP9 } tape numbers for scratch units
NAT		NTP2 } tape numbers for scratch units

MNEMONICS	SYMBOL	DESCRIPTION
NW		NTP3, tape number for the solution matrix
LTAPE		Tape number assigned to the tape containing the quasi-inverse of [D]
RHSTAP		NTP4; tape number assigned to tape containing the matrix of right hand sides

For present assignment of tape units see Sec. 2.4

2.5.18 SUBRØUTINE FUTSØL (ND, MD, KD, NI, MM, NØ, NAT, NW, LTAPE, RHSTAP)

Functional Description

Subroutine FUTSØL is used for cases with NCØRE ≥ 4000, and whenever new modes only are required for a previously computed case (N1 = 1). When N1 = 0, subroutine FUTSØL is called following subroutine QUAS, and uses the quasi-inverse of the matrix [D] from tape LTAPE. Additional right hand sides are read from tape RHSTAP, and the additional solutions are saved on tape NTP3 following the previously obtained solutions.

Subroutine FUTSØL is bypassed when N5 = 1 and NCØRE < 3700.

Data from Cards

None

Data from Common

None

Data from Tapes

MNEMONICS	SYMBOL	TAPE	DESCRIPTION
A(3700)	[W]	RHSTAP	Additional columns of right hand sides
A(3700)		LTAPE	The quasi-inverse matrix generated in QUAS

Data to Common

None

Data to Tapes

MNEMONICS	SYMBOL	TAPE	DESCRIPTION
A(3700)		NW	The additional solutions for the additional right hand sides

For present assignment of tape units see Sec. 2.4.

Data in Argument List

Same as for QUAS - see 2.5.17, except that NI is now merely a scratch unit and does not contain the input matrix [D].

2.5.19 SUBRØUTINE AIC(BR, S, KR, NBF, NBL, JØBNØ, ICØD, VEL, NGUST, NPR2)

Functional Description

Subroutine AIC is used for AIC-type cases only. It reads the solutions to the AIC-type elastic modes from tape NTP3 and the partioned integration matrix, [B], from tape NTP10. Using these arrays subroutine AIC supercolumns according to Eq. 2.5-1*, and saves them on tape NTP9.

*See Part I, Vol I

Data from Cards

None

Data from Common

Contents of the labeled common blocks /NTPS/, /XYZ/ and /YZY/.

Data from Tapes

MNEMONICS	SYMBOL	TAPE	DESCRIPTION
NSTRIP			
NSIZE(50, 2)		NTP10	See 2. 5. 3
LIM(50, 3)			
B(10, 30)	$[B]_{AIC}$		Integration matrix
DIJM1W(400, 4)	$[D]^{-1}[W]_{AIC}$	NTP3	Solution matrix for the AIC type right hand sides
CPGUST(400)		NTP3	Solution for the gust right hand side - read only if NGUST ≠ 0.

Data to Common

None

Data to Tapes

MNEMONICS	SYMBOL	TAPE	DESCRIPTION
CH(4, 4, 50)		NTP9	AIC matrix written one supercolumn at a time; see Eq. 2. 6-2. *

*See Part I, Vol I

Data in Argument List

MNEMONICS	SYMBOL	DESCRIPTION	
BR	b_r, c/2	Reference semichord	
S, REFSPN	$b/2$, s	Reference semispan - input	
KR	$b/2$,	Reduced frequency	
NBF		First bay number	for which AIC's are written on tape
NBL		Last bay number	
JØBNØ		AIC-case-identifier	
ICØD		1, built in constant	
VEL		Aircraft velocity	- input
NGUST		Gust flag	
NPR2		Print flag for AIC's	

2.5.20 SUBRØUTINE AERØ (BR, B2, KR, ACAP, NRF, NSV, NYAW, IMX, NPC, NDELT, NPR3)

Functional Description

Subroutine AERØ is used for AIC-type cases only. It reads the AIC supercolumns from tape NTP9 and computes the stability derivatives for the rigid body modes according to Eqs. (2.4-6) - (2.4-12).* This subroutine is primarily used for the monitoring of the AIC's. It can be bypassed by setting the data flag NPR3 to 0.

Data from Cards

None

Data from Common

Contents of the labeled commons /NTPS/, /XYZ/ and /ZYZ/.

*See Part I, Vol I

Data from Tapes

MNEMONICS	SYMBOL	TAPE	DESCRIPTION
NSTRIP		NTP10	See 2. 5. 3
NSIZB(50, 2)			
LIM(50, 3)			
XISLCT(50, 7)			
CH(4, 4, 50)		NTP9	See 2. 5. 19

Data to Common

None

Data to Tapes

Usually none. However, in special cases, when dynamic stability derivatives are also required (input flag NPR3=3), tape unit 2 is used for saving the total lift-and moment coefficients computed for the steady case (KR(1) = 0. 0). Subsequently, this information is read from tape unit 2 and is used in the calculation of the dynamic stability derivatives for the unsteady case (KR(2) > 0. 0) - see 2. 4. 2, in Part I, Vol I.

Data in Argument List

MNEMONICS	SYMBOL	DESCRIPTION
BR	b_r, $c/2$	See 2. 5. 19
B2	b_2, s	
KR	k_r	
ACAP, REFARA	A, S	Reference area - input

MNEMONICS	SYMBOL	DESCRIPTION
NRF		Number of reduced frequencies for case - input
NSV		Number of strips on vertical panels (fin) of T-tail cases; 0 otherwise - input
NYAW		Yaw flag - input
IMX		Number of rigid body modes for AIC-type case-from GENB
NPC		Camber flag - input
NDELT	δ	Symmetry flag - input
NPR3		Print flag - input

2.5.21 SUBRØUTINE FINAL (BR, B2, ACAP, NSV, NBV, IMX, NYAW, NPC, NDELT, FGAMMA)

Functional Description

Subroutine FINAL is used for AIC-type cases only. It reads the solutions for the AIC-type right hand sides from tape NTP3 and computes the pressures for the rigid body modes for all boxes of all lifting surfaces. These are printed along with the box number and the fractional chordwise location of the load points (1/4-chord of box). Subroutine FINAL can be bypassed by setting the data flag NPR3 to 0.

Data from Cards

None

Data from Common

Contents of the labeled commons /NTPS/, /XXZ/, and /YZY/.

Data from Tapes

MNEMONICS	SYMBOL	TAPE	DESCRIPTION
NSTRIP		NTP10	See 2.5.3
NSIZB(50,2)			
LIM(50,3)			
CPM(400,4)		NTP3	Solution matrix for the AIC-type right hand sides

Data to Common

None

Data to Tapes

None

Data in Argument List

MNEMONICS	SYMBOL	DESCRIPTION
BR	b_r	See 2.5.20
B2	$b/2$, s	
ACAP, REFARA	A, S	
NSV		
NBV		Total number of boxes on vertical panels (fin) of T-tail cases - input
IMX		See 2.1.2
NYAW		
NPC		
NDELT	δ	
FGAMMA(50)		Array of dihedral angles for all strips of all lifting surfaces.

2.5.22 SUBRØUTINE GENF (NBØX, NTØT, NMD, NDELT, NST, LIM, FL, XCAP, XIJ, EV, SDELX, B2, Y, ZZ, XØC, NBV)

Functional Description

Subroutine GENF is used for modal type cases only. It reads the solutions for all modes from tape NTP3 and writes the pressures for all modes and all boxes along with the x, y, z coordinates of the boxes. It also computes the sectional lift and moment coefficients for all strips of all lifting surfaces as well as the total lift- and moment coefficients - see Eqs. (2.4-6)-(2.4-12)*Subroutine GENF also computes the generalized forces for all pressure modes and deflection modes; see Eq. 2.4-5*

Data from Cards

None

Data from Common

Contents of the labeled common blocks /NTPS/, /XYZ/ and /BØDY/.

Data from Tapes

MNEMONICS	SYMBOL	TAPE	DESCRIPTION
P(400)	$\left\{\Delta C_p\right\}$	NTP3	Solution matrix for modal type data read in column order. Dimension of matrix is NBØXxNMD.
P(400)	$\left\{\Delta C_p^{(f)}\right\}$	NTP7	Matrix of pressures for all body elements and modes read in column order. Dimension of matrix is NBExNMD. This data is read for body cases only.
B(400)		NTP10	Integration matrix for modal type data read in column order. Dimension of matrix is NTØTxNMD where NTØT = NBØX + NBE.

Data to Common

None

*See Part I, Vol I

Data to Tapes

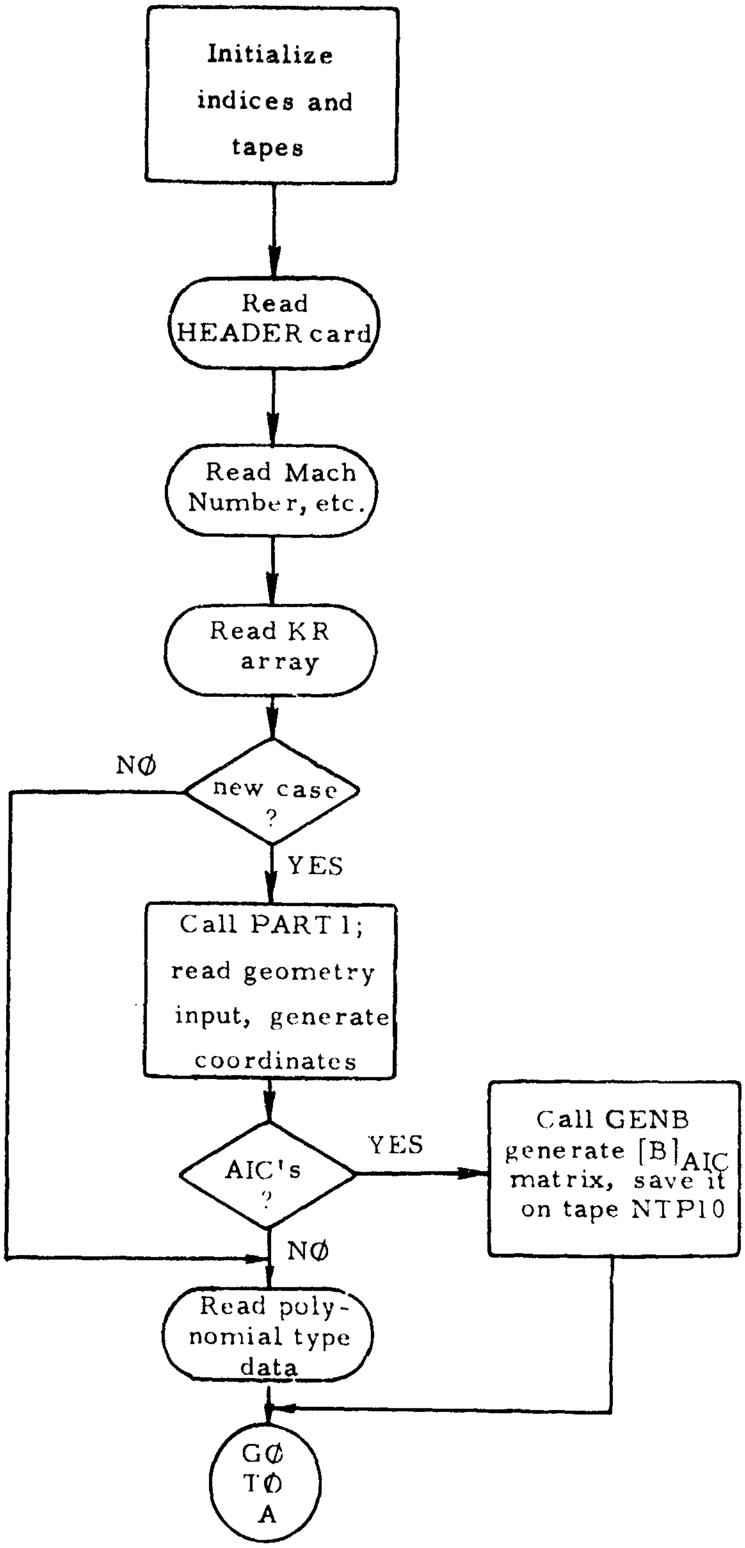
None

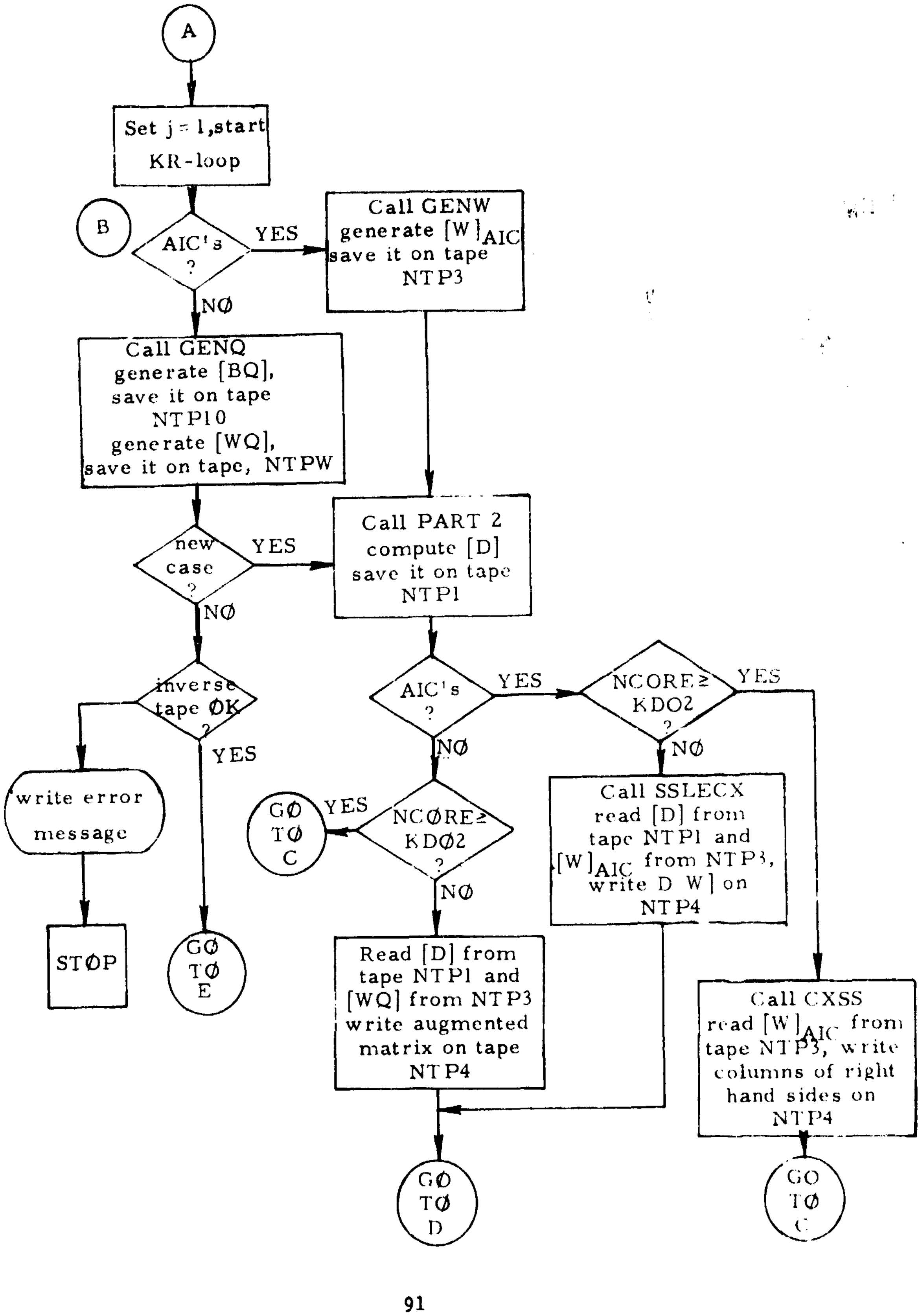
Data in Argument List

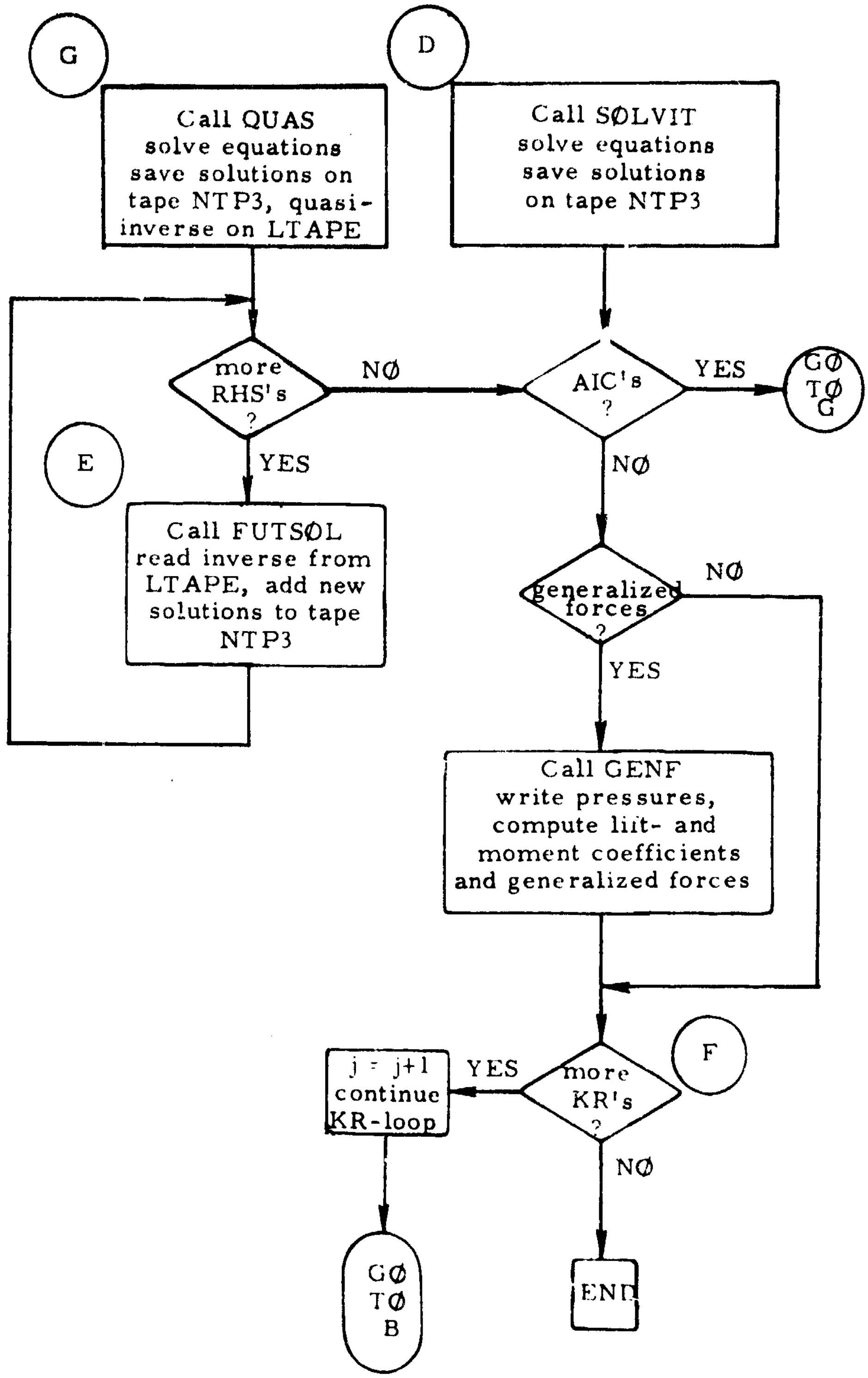
MNEMONICS	SYMBOL	DESCRIPTION
NDELT	δ	Symmetry flag - input
NB		Number of bodies - input
NSTRIP		Number of strips - input
NBØX		Total number of boxes on all panels
NTØT	n	NBØX + NBE, where NBE = total number of body elements
NBV		T-tail input
NSV		T-tail input
NMD	NM, m	Number of modes - input
LIM(50, 3)		See Sec. 2.5.3
ACAP, REFARA	A, S	See Blank Common, Sec. 2.3.1
FL, REFCHD	$\bar{c}$, $2b_r$	See Blank Common, Sec. 2.3.1
B2, REFSPN	s, b/2	See Blank Common, Sec. 2.3.1
EV(400)	ξ	See Blank Common, Sec. 2.3.1
Y(400)	y	See Blank Common, Sec. 2.3.1
ZZ(400)	z	See Blank Common, Sec. 2.3.1
SDELX(400)	Δx_s	See Blank Common, Sec. 2.3.1
XIJ(50)	$x_{\ell e}$	See Common /XXZ/, Sec. 2.3.2
XØC(400)	ξ/c	See Common /XXZ/, Sec. 2.3.2

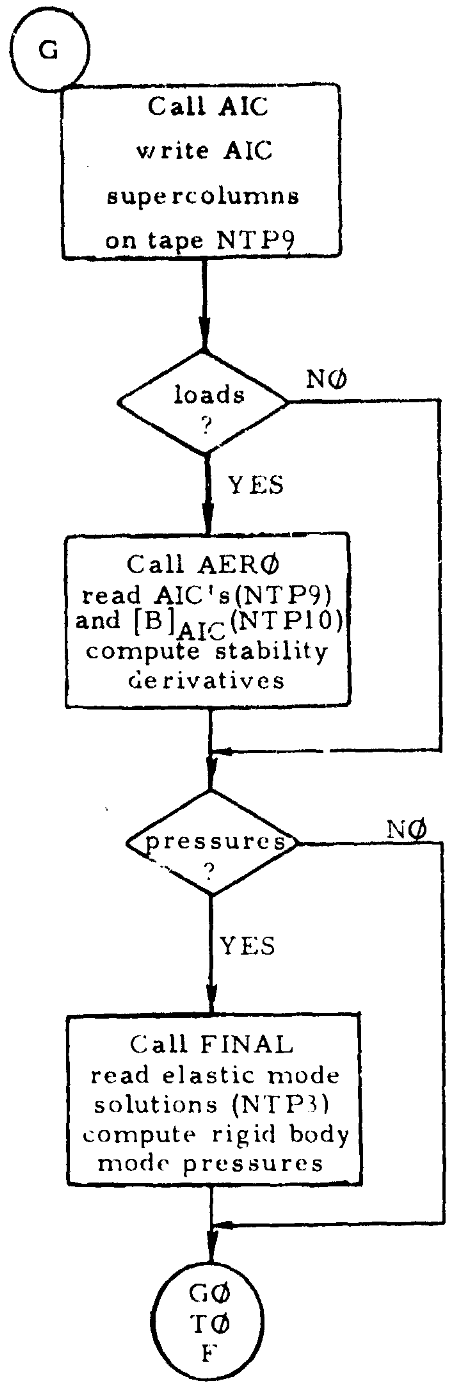
2.6 BLOCK DIAGRAM

The basic block diagram for the computer progrm H7WC is shown on the next four pages. All logical steps in the "main" part of the program are indicated, and the basic functions of all subroutines that are called from "main" are outlined. A complete description of all subroutines — including those that are not called directly from "main," and therefore are not indicated in the block diagram — can be found in Sections 2.5.1 through 2.5.22.


Initialize
indices and
tapes
Read
HEADER card
Read Mach
Number, etc.
Read KR
array
NØ
new case
?
YES
Call PART 1;
read geometry
input, generate
coordinates
AIC's
?
YES
Call GENB
generate [B]AIC
matrix, save it
on tape NTP10
NØ
Read poly-
nomial type
data
GØ
TØ
A


A
Set j = 1,start KR-loop
B
AIC's ?
YES
Call GENW generate [W]AIC save it on tape NTP3
NØ
Call GENQ generate [BQ], save it on tape NTP10 generate [WQ], save it on tape, NTPW
new case ?
YES
Call PART 2 compute [D] save it on tape NTP1
NØ
inverse tape ØK ?
YES
write error message
STØP
GØ TØ E
AIC's ?
YES
NCORE≥ KDO2 ?
YES
NØ
Call SSLECX read [D] from tape NTP1 and [W]AIC from NTP3, write D W] on NTP4
NØ
NCØRE≥ KDØ2 ?
YES
GØ TØ C
NØ
Read [D] from tape NTP1 and [WQ] from NTP3 write augmented matrix on tape NTP4
Call CXSS read [W]AIC from tape NTP3, write columns of right hand sides on NTP4
GØ TØ D
GO TØ C


G
D
Call QUAS
solve equations
save solutions on
tape NTP3, quasi-
inverse on LTAPE
Call SØLVIT
solve equations
save solutions
on tape NTP3
more
RHS's
?
NØ
AIC's
?
YES
GØ
TØ
G
E
YES
NØ
Call FUTSØL
read inverse from
LTAPE, add new
solutions to tape
NTP3
generalized
forces
?
NØ
YES
Call GENF
write pressures,
compute lift- and
moment coefficients
and generalized forces
j = j+1
continue
KR-loop
YES
more
KR's
?
F
NØ
GØ
TØ
B
END


G
Call AIC
write AIC
supercolumns
on tape NTP9
loads
?
NØ
YES
Call AERØ
read AIC's(NTP9)
and [B]AIC(NTP10)
compute stability
derivatives
pressures
?
NØ
YES
Call FINAL
read elastic mode
solutions (NTP3)
compute rigid body
mode pressures
GØ
TØ
F

2.7 PROGRAM LISTING

The following pages (pp. 95 - 143) contain the complete listing of program H7WC. The individual subroutines of the program (including the "main" part of it) are listed in the order of their description in Section 2.5.

```
MAIN          - EFN   SOURCE STATEMENT  -  IFN(S)  -                     01/15/71

C      AER FORCE PROGRAM - LIFTING SURFACE THEORY * 10/01/70 VERSION      MAIN0005
       DIMENSION KMFQ(20)                                                 MAIN0010
       DIMENSION LIM(50,3)                                                MAIN0020
       COMPLEX   AUGM(50), HH(50)                                         MAIN0030
       DIMENSION WF(20),WFY(20),COEFP(20),COEFB(20),YIN(20),ZIN(20)       MAIN0040
       REAL  KR,KRDBR                                                     MAIN0050
       COMMON  NCNSM1,NB,NDELT,NDATA,NOPAN,IQ,IR,JSPECS,FMACH,NCARAY(20), MAIN0060
      1        NSARAY(20),NBARAY(20),ACAP,B2,FL,BETA,PI,KR,KRDBR,GMA(50), MAIN0070
      2        X(400),Y(400),Z(400),Z1(400),P1(400),ZZ1(400),ZZ(400),     MAIN0080
      3        PZ(400),PZZ(400),EV(400),PV(400),ZV(400),SDELX(400),      MAIN0090
      4        DELY(400)                                                  MAIN0100
       COMMON /AYZ/YS(50),DELYS(50),ZS(50),DELZS(50),FGAMMA(50),CHIG(50)  MAIN0110
       COMMON /YZ/    E1A(50), E3A(50),  E5A(50),E7A(50),E2A(50)          MAIN0120
       COMMON  /AA/   NDC(400),EIJ(50)                                    MAIN0130
       COMMON  /TIGM/  CT1(20),CT2(20),TS(50)                             MAIN0140
       COMMON  /NTPS/  NTP1,NTP2,NTP3,NTP4,NTP5,NTP6,NTP7,NTP8,NTP9,NTP10 MAIN0150
       COMMON  /BODY/ BMS 00),BOP( 00),NBEA(20),PGMA(20),NRK(20,2)        MAIN0160
       REAL    E10,E20,E10T1,E11T1,E20T2P,E21T2P,E10T1,E20T2P             MAIN0170
       COMMON  /ALM/  E10,E20,E10T1,E11T1,E20T2P,E21T2P,S10T1,E20T2P,E2   MAIN0180
       DIMENSION          HDR(15)                                         MAIN0190
       INTEGER  CAPTAP                                                    MAIN0200
       DATA  STOP/6HSTOP  /                                               MAIN0210
     3 FORMAT  (1H0,25X,22HMOUNTING INVERSE TAPE NO.//)                   MAIN0220
     9 FORMAT (1H0,15I5)                                                  MAIN0230
    15 FORMAT  (15A4)                                                     MAIN0240
    16 FORMAT  (1H1,15A4)                                                 MAIN0250
    18 FORMAT  (4F10.0,4I2,I6,4I1)                                        MAIN0260
    20 FORMAT  (4F10.0)                                                   MAIN0270
    25 FORMAT  (8F10.0)                                                   MAIN0280
    35 FORMAT  (5I2,2I10,2I2,2I3)                                         MAIN0290
    45 FORMAT  (3X,5I2,F10.0))                                            MAIN0300
    47 FORMAT  (3X,14,3I3))                                               MAIN0310
    55 FORMAT  (I3,3I3,I4,3I3,I15,I5,I4,5I4,2I2)                          MAIN0320
    80 FORMAT (1H1,9X,61HNO. OF BAYS INCOMPATIBLE WITH NO. OF STRIPS//)   MAIN0330
    82 FORMAT (1H0,30X,34HHO   ARRAY OF REDUCED FREQUENCIES   **//)       MAIN0340
    84 FORMAT (1H0,10X,10F11.6)                                           MAIN0350
   100 CONTINUE                                                           MAIN0360
       NPG1 = 0                                                           MAIN0370
       NTP1 = 1                                                           MAIN0380
       NTP2 = 13                                                          MAIN0390
       NTP3 = 3                                                           MAIN0400
       NTP4 = 4                                                           MAIN0410
       NTP5 = 5                                                           MAIN0420
       NTP6 = 6                                                           MAIN0430
       NTP7 = 12
       NTP8 = 8                                                           MAIN0450
       NTP9 = 9                                                           MAIN0460
       NTP10= 10                                                          MAIN0470
       LTAPE= 11                                                          MAIN0480
       NAT  = NTP7                                                        MAIN0490
       REWIND LTAPE                                                       MAIN0500   16
       IG = 3                                                             MAIN0520
       ISS  = 9                                                           MAIN0530
       NO   = 3                                                           MAIN0540
       NMD  = 3                                                           MAIN0550
```

95

```
MAIN          - EFN   SOURCE STATEMENT  -  IFN(S)  -                     01/15/71

       NGUST= 0                                                           MAIN0560
       PI   = 3.14159265                                                  MAIN0570
       KD   = 8000                                                        MAIN0580
       KDO2 = KD/2                                                        MAIN0590
       DO 109  K=1,20                                                     MAIN0600
   109 NBARAY(K)= 0                                                       MAIN0610
       READ  (5,15) (HDR(I), I=1,15)                                      MAIN0620   18
       IF (HDR(1).EQ.STOP) STOP                                           MAIN0630
       WRITE (6,16) (HDR(I), I=1,15)                                      MAIN0640   36
       READ  (5,18) FMACH,ACAP,FL,B2,NDELT,NP,NB,NRF,NCORE,N1,N2,N3,N4    MAIN0650   43
       BR    = FL/2.0                                                     MAIN0660
       S     = B2                                                         MAIN0670
       NDATA= N3                                                          MAIN0680
       NOPAN= NP                                                          MAIN0690
       BETA = SQRT(1.0-FMACH**2)                                          MAIN0700   55
       READ  (5,25) (RFREQ(I), I=1,NRF)                                   MAIN0710   56
       WRITE (6,82)                                                       MAIN0720   63
       WRITE (6,84) (RFREQ(I), I=1,NRF)                                   MAIN0730   64
       IF (N1.EQ.1)  GO TO 110                                            MAIN0740
       CALL          PART1(JCUM,COEFP,COEFB,YIN,ZIN)                      MAIN0760   74
       NBOX = NCNSM1                                                      MAIN0770
       NSTRIP=JCUM                                                        MAIN0780
       NBE   = 0                                                          MAIN0790
       IF (NB.NE.0)  NBE=NBEA(NB)                                         MAIN0800
       NTOT = NBOX+NBE                                                    MAIN0810
       READ  (5,55)  NSTRIP,NB1,NB2,NPR1, NPR2,NPR3,JOBNO,JOBNO2,NGUST,   MAIN0820
      1              JSPECS,NPC,NSV,NBV,NYAW                              MAIN0830   82
       IF (NGUST.NE.0)  READ (5,20)  GZRO,XZRO, VEL, WG                   MAIN0835   97
       READ  (5,47)  (LIM(I,1), LIM(I,2), LIM(I,3),  I=1,NSTRIP)          MAIN0840   98
   110 CONTINUE                                                           MAIN0850
       IF (N2.EQ.0)  GO TO 122                                            MAIN0860
       CALL          GENB(EV,SDELX,DELY,X,NSTRIP,BETA,INX,NPC,NP,NSARAY,LIM)MAIN0890  111
       NBF   = NB1                                                        MAIN0900
       NBL   = NB2                                                        MAIN0910
       NSTR = NB2-NB1+1                                                   MAIN0920
       NSTRPG=NSTR                                                        MAIN0930
       IF (NGUST.NE.0) NSTRPG=NSTR+1                                      MAIN0940
   122 CONTINUE                                                           MAIN0950
       NCSFTO= NCNSM1+NBE                                                 MAIN0960
       IF (N2.EQ.0) READ(5,35) NMD,NTA,N5,N6,N7,NTPI,NTPM,NMTP,NMTB       MAIN0970  121
       IF (N5.EQ.1)  WRITE (LTAPE) NTPI                                   MAIN0980  132
       DO 160  J=1,NRF                                                    MAIN0990
       JRF   = J                                                          MAIN1000
       IQ    = 0                                                          MAIN1010
       KR    = RFREQ(J)                                                   MAIN1020
       KRDBR= RFREQ(J)/BR                                                 MAIN1030
       IF (N2.EQ.0)  GO TO 125                                            MAIN1040
       CALL          GENM(KRDBR,NCSFTO,NPC,NGUST,WG,GZRO,XZRO)            MAIN1060  144
       GO TO 127                                                          MAIN1070
   125 CONTINUE                                                           MAIN1080
       CALL          GENQ(N4,N5,N6,NRF,JRF,NBE,      NMD,NMTP,NMTB,NCORE, MAIN1100
      1              KDO2,YIN,ZIN,COEFP,COEFB)                            MAIN1110  147
       IF (N1.EQ.1)  GO TO 152                                            MAIN1120
   127 CONTINUE                                                           MAIN1130
       REWIND  NTP1                                                       MAIN1140  152
       NBODY= NB                                                          MAIN1145
```

```
      MAIN          - EFN    SOURC  STATEMENT  -  IFN(S)  -                     01/15/71

      CALL           PART2(NYAW,NBV)                                            MAIN1160     154
      NB    = NBODY                                                             MAIN1165
      IF (N2.EQ.0)   GO TO 145                                                  MAIN1170
      IF (NCORE.GT.NBOD2)   GO TO 142                                           MAIN1180
      CALL           SSLOCA(NCNSR1,ND,NGUST)                                    MAIN1200     163
      GO TO 150                                                                 MAIN1210
  142 CONTINUE                                                                  MAIN1220
      CALL           LASS  (NCNSR1,ND,NGUST)                                    MAIN1240     166
      GO TO 152                                                                 MAIN1250
  145 CONTINUE                                                                  MAIN1260
      ND    = NND                                                               MAIN1270
      IF (N3.NE.0)   GO TO 152                                                  MAIN1280
      IF (NCORE.LT.NBOD2.OR.N5.NE.0)   GO TO 152                                MAIN1290
      REWIND  NTP1                                                              MAIN1300     175
      REWIND  NTP3                                                              MAIN1310     176
      REWIND  NTP6                                                              MAIN1320     177
      NBDX  = NCNSR1                                                            MAIN1330
      NBXP1= NBDX+1                                                             MAIN1340
      NAUG  = NBDX+NND                                                          MAIN1350
      DO 149 I = 1,NBDX                                                         MAIN1360
                                                                                MAIN1370
      READ (NTP1)   (AUGM(L), L=1,NBDX)                                         MAIN1380     182
      READ (NTP3)   (HB(K),    K=1,NND )                                        MAIN1390
                                                                                MAIN1400     187
      KK    = 0                                                                 MAIN1410
      DO 147 II= NBXP1,NAUG                                                     MAIN1420
      KK    = KK+1                                                              MAIN1430
      AUGM(II) = HB(KK)                                                         MAIN1440
  147 CONTINUE                                                                  MAIN1450
      WRITE (NTP6)   (AUGM(L),   L=1,NAUG)                                      MAIN1460     199
  149 CONTINUE                                                                  MAIN1470
  150 CONTINUE                                                                  MAIN1480
      ND    = NBDX                                                              MAIN1490
      NI    = NTP6                                                              MAIN1500
      NO    = NTP1                                                              MAIN1510
      NT    = NTP9                                                              MAIN1520
      NW    = NTP3                                                              MAIN1530
      REWIND NO                                                                 MAIN1540     211
      CALL           SOLVIT(ND,NB,KD,NI, M,NO,NW,NPR1)                          MAIN1560     212
      IF (N2.EQ.0)   GO TO 157                                                  MAIN1570
      GO TO 154                                                                 MAIN1580
  152 CONTINUE                                                                  MAIN1590
      NI    = NTP1                                                              MAIN1600
      KD    = 1700                                                              MAIN1610
      ND    = NBDX                                                              MAIN1620
      M     = 0                                                                 MAIN1630
      MM    = NTP8                                                              MAIN1640
      NO    = NTP9                                                              MAIN1650
      NW    = NTP3                                                              MAIN1660
      RHSTAP=NTP6                                                               MAIN1670
      REWIND NI                                                                 MAIN1680     226
      REWIND NM                                                                 MAIN1690     227
      REWIND LTAPE                                                              MAIN1700     228
      REWIND RHSTAP                                                             MAIN1710     229
      IF (N1.EQ.0)   GO TO 453                                                  MAIN1720
      READ (LTAPE)   NTPOLD                                                     MAIN1730     232
```

```
      MAIN          - EFN    SOURCE STATEMENT  -  IFN(S)  -                     01/15/71

      IF (NTP1.EQ.NTPOLD)   GO TO 8000                                          MAIN1740
      WRITE (6, 3)                                                              MAIN1750     236
      STOP                                                                      MAIN1760
  453 REWIND LTAPE                                                              MAIN1770     237
      REWIND NAT                                                                MAIN1775     238
      IWHICH = 1                                                                MAIN1780
      CALL           QUAS   (ND,M ,KD,NI,MM,NO,NAT,NW,LTAPE,RHSTAP,NPR1)        MAIN1800     240
      IF( M .EQ. 0 ) GO TO 8000                                                 MAIN1810
      IF (M.EQ.NMD)      IWHICH=2                                               MAIN1820
  450 CONTINUE                                                                  MAIN1830
      REWIND NW                                                                 MAIN1840     247
      GO TO (8000,9002),IWHICH                                                  MAIN1850
 8000 CONTINUE                                                                  MAIN1860
      CALL           FUTSOL(ND,M ,KD,NI,MM,NO,NAT,NW,LTAPE,RHSTAP,NPR1)         MAIN1880     250
      IF (M.EQ.NMD)   IWHICH=2                                                  MAIN1885
      GO TO 450                                                                 MAIN1890
 9002 CONTINUE                                                                  MAIN1900
  154 CONTINUE                                                                  MAIN1910
      IF (N2.EQ.0)      GO TO 157                                               MAIN1920
      ICOD = 1                                                                  MAIN1930
      CALL           AIC(BR,S, KR,NBF,NBL,JOBNO,ICOD,VEL,NGUST,NPR2)            MAIN1950     261
      IF (NPR3.EQ.0)   GO TO 160                                                MAIN1960
      CALL           AERO(BR,B2,KR,ACAP,NRF,NSV,NYAW,IMX,NPC,NDELT,NPR3)        MAIN1980     266
      CALL           FINAL(BR,B2,ACAP,NSV,NBV,IMX,NYAW,NPC,NDELT,FGAMMA)        MAIN2000     268
      GO TO 160                                                                 MAIN2010
  157 CONTINUE                                                                  MAIN2020
      IF (N7.EQ.0)   GO TO 160                                                  MAIN2030
      CALL           GENF(NDELT,NB,NSTRIP,NBOX,NTOT,NBV,NSV,NMD,LIM,ACAP,FL,    MAIN2050
     1               B2,EV,Y,ZZ,SDELX,XIJ,XOC,X)                                MAIN2060     274
  160 CONTINUE                                                                  MAIN2070
      GO TO 100                                                                 MAIN2080
      END                                                                       MAIN2090
```

```
ATAN3        - EFN   SOURCE STATEMENT  -  IFN(S)  -                      01/15/71

      SUBROUTINE ATAN3(Y,X,T)                                            ATAN0010
      PI = 3.141593                                                      ATAN0020
      PI2 = PI*2.0                                                       ATAN0030
      IF(X.EQ.0.) T=PI/2.                                                ATAN0040
      IF(X.EQ.0.) GO TO 2                                                ATAN0050
      IF(Y.EQ.0.)T=0.                                                    ATAN0060
      IF(Y.EQ.0.0) GO TO 2                                               ATAN0070
      A = Y/X                                                            ATAN0080
      T = ATAN(A)                                                        ATAN0090   12
    2 CONTINUE                                                           ATAN0100
      IF((Y.GE.0.).AND.(X.EQ.0.)) GO TO 1                                ATAN0110
      IF ((Y.EQ.0.).AND.(X.GT.0.)) T=0.                                  ATAN0120
      IF ((Y.EQ.0.).AND.(X.GT.0.)) GO TO 1                               ATAN0130
      IF((Y.GE.0.).AND.(X.LE.0.))T = PI + T                              ATAN0140
      IF((Y.GE.0.).AND.(X.LE.0.))GO TO 1                                 ATAN0150
      IF((Y.LE.0.).AND.(X.LE.0.))T = PI + T                              ATAN0160
      IF((Y.LE.0.).AND.(X.LE.0.))GO TO 1                                 ATAN0170
      IF((Y.LE.0.).AND.(X.GE.0.))T = PI2+ T                              ATAN0180
      IF((Y.LE.0.).AND.(X.GE.0.))GO TO 1                                 ATAN0190
    1 CONTINUE                                                           ATAN0200
      RETURN                                                             ATAN0210
      END                                                                ATAN0220
```

```
      SUBROUTINE PART1(JCUM,COEFP,COEFB,YIN,ZIN)                            PRT10010
      REAL     KH,KRDBR                                                     PRT10020
      COMMON   NCNSM1,NB,NOELT,NDATA,NOPAN,IO,IR,JSPECS,FMACH,NCARAY(20),PRT10030
     1         NSARAY(20),NBRRAY(20),ACAP,S2,FL,BETA,PI,KR,KRDBR,GMA(50),PRT10040
     2         X(400),Y(400),ZZ(400),Z1(400),P1(400),ZZ1(400),ZZ(400),      PRT10050
     3         P2(400),ZZ2(400),EV(400),PV(400),ZV(400),SDELX(400),         PRT10060
     4         DELY(400)                                                    PRT10070
      COMMON /XYZ/YS(50),DELYS(50),ZS(50),DELZS(50),FGAMMA(50),CHIG(50) PRT10080
      COMMON  /XXZ/  XUC(400),XIJ(50)                                       PRT10090
      COMMON  /PIGM/  CT1(20),CT2(20),TS(50)                                PRT10100
      DIMENSION  XCAP(4),YCAP(2),ZCAP(2),GMAS(50),                          PRT10110
     1 ZETA(400),PNU(400),ZEE(400),TH(50),TAU(50),DELZ(400) ,RAD(50)        PRT10120
      DIMENSION FY(5,20), RY(5,20),COEFP(20), COEFB(20),F(50)               PRT10130
      DIMENSION  YIN(20), ZIN(20), NFZ(20),NFY(20)                          PRT10140
      COMMON  /BODY/ R(( 80),ROP( 80),NBFA(20),BGMA(20),NRK(20,2)           PRT10150
   10 FORMAT  (6F10.0)                                                      PRT10160
   20 FORMAT  (6I2)                                                         PRT10170
   25 FORMAT  (2F10.0,1X,2I3,3X,F10.0)                                      PRT10180
   30 FORMAT (1H0,5X,4HX1 =,F12.6,6H  X2 =,F12.6, 6H  Y1 =,F12.6, 6H  Z1PRT10190
     1 =,F12.6//6X,4HX3 =,F12.6,6H  X4 =,F12.6,6H  Y2 =,F12.6,6H  Z2 =, PRT10200
     2   F12.6//6X,4HNC =, I3,  6H  NS =, I3,  9H  NOELT =, I3, 17H  NO.PRT10210
     3 OF PANELS =, I3//)                                                   PRT10220
   35 FORMAT (2F10.0,1X,3I2,3X,F10.0,2I3)                                   PRT10230
   60 FORMAT (1H0,10X,12HREF. CHORD =, F15.5, 18H  REF. SEMI-SPAN =,        PRT10240
     1        F15.5, 13H  REF. AREA =,  F15.5//10X,10HMACH NO. =, F12.5, PRT10250
     2        9H   BETA =, F12.5//)                                         PRT10260
   65 FORMAT (1H0,25X,12H*** BODY NO.,I4,18H  INPUT VALUES ***// 15X,       PRT10270
     1 32HCENTER OF BODY COORDINATES   Y =, F16.6,5X, 3HZ =, F16.6//15X,PRT10280
     2 7HYFLAG =,I3, 9H  ZFLAG =,I3,10X, 24HMODE SHAPE COEFFICIENT =,       PRT10290
     3  I6.5//15X,17HBODY BOX LIMITS =,2I5//)                               PRT10300
   50 FORMAT (1H0,25X,13H*** PANEL NO.,I5,2X,16HINPUT VALUES ***)           PRT10310
   70 FORMAT (1H0,25X, 36HLIFTING SURFACE HAS PARABOLIC CAMBER//)           PRT10320
   80 FORMAT (1H0,6I6//)                                                    PRT10330
  100 FORMAT (2F10.0,3I2,50X,I4)                                            PRT10340
  110 FORMAT (1H0,25X, I4,31H DIHEDRAL ANGLES FOR ALL PANELS//)             PRT10350
  115 FORMAT (1H0,40X,I4,27H BODY ELEMENTS FOR BODY NO., I4/)               PRT10360
  120 FORMAT (1H0,45X, I4,27H ZEE ELEMENTS FOR PANEL NO.,I4 //)             PRT10370
  125 FORMAT (1H0,42X,I4,25H BODY RADII  FOR BODY NO.,   I4/)               PRT10380
  130 FORMAT (1H0,45X, I4,29H  Z  ELEMENTS FOR ALL PANELS//)                PRT10390
  135 FORMAT (1H0,45X,I4,28H  X  ELEMENTS FOR ALL BODIES//)                 PRT10400
  140 FORMAT (1H0,45X, I4,28H Z-1 ELEMENTS FOR ALL PANELS//)                PRT10410
  145 FORMAT (1H0,45X,I4,28H XIV ELEMENTS FOR ALL BODIES//)                 PRT10420
  150 FORMAT (1H0,45X, I4,28H Z-2 ELEMENTS FOR ALL PANELS//)                PRT10430
  155 FORMAT (1H0,45X,I4,29H  Y  ELEMENTS FOR ALL BODIES//)                 PRT10440
  160 FORMAT (1H0,45X, I4,29H Z-Y ELEMENTS FOR ALL PANELS//)                PRT10450
  165 FORMAT (1H0,45X,I4,28H  Z  ELEMENTS FOR ALL BODIES//)                 PRT10460
  170 FORMAT (1H0,6E20.9)                                                   PRT10470
  175 FORMAT (1H0,45X,I4,29H DX  ELEMENTS FOR ALL BODIES//)                 PRT10480
  180 FORMAT (1H0,25X,I4,2X,29HCHORDWISE DIVISIONS FOR PANEL,I3//)          PRT10490
  185 FORMAT (1H0,45X,I4,28H RAD ELEMENTS FOR ALL BODIES//)                 PRT10500
  190 FORMAT (1H0,25X,I4,2X,29H SPANWISE DIVISIONS FOR PANEL,I3//)          PRT10510
  200 FORMAT (1H0,40X,I4,2X,26H***  XI ELEMENTS FOR PANEL,I3,3H***)         PRT10520
  210 FORMAT (1H0,40X,I4,2X,26H*** ETA ELEMENTS FOR PANEL,I3,3H***)         PRT10530
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220 FORMAT (1HO,45X,I4,2X,32H*** -X- ELEM. FOR ALL PANELS ***)        PRT10540
230 FORMAT (1HO,45X,I4,2X,32H*** -Y- ELEM. FOR ALL PANELS ***)        PRT10550
240 FORMAT (1HO,45X,I4,2X,32H*** XI-1 ELEMENTS ALL PANELS ***)        PRT10560
250 FORMAT (1HO,45X,I4,2X,32H*** XI-2 ELEMENTS ALL PANELS ***)        PRT10570
260 FORMAT (1HO,45X,I4,2X,32H*** ETA1 ELEMENTS ALL PANELS ***)        PRT10580
270 FORMAT (1HO,45X,I4,2X,32H*** ETA2 ELEMENTS ALL PANELS ***)        PRT10590
280 FORMAT (1HO,45X,I4,2X,32H*** XI-V ELEMENTS ALL PANELS ***)        PRT10600
290 FORMAT (1HO,45X,I4,2X,32H*** ETAV ELEMENTS ALL PANELS ***)        PRT10610
300 FORMAT (1HO,45X, I4,26H BOX WIDTHS FOR ALL PANELS//)              PRT10620
320 FORMAT (1HO,45X,38H****** SDELX ELEM. FOR ALL PANELS *****)       PRT10630
330 FORMAT (1HO,25X,23HC.WIGGLES FOR PANEL NO.,I4,1X,5H*****)        PRT10640
340 FORMAT (1HO,50X, 14HDELY-S FOR THE,I4, 7H STRIPS//)              PRT10650
350 FORMAT (1HO,50X, 14H   Y-S FOR THE,I4, 7H STRIPS//)              PRT10660
360 FORMAT (1HO,50X, 14H   Z-S FOR THE,I4, 7H STRIPS//)              PRT10670
370 FORMAT (1HO,50X, 14HDELZ-S FOR THE,I4, 7H STRIPS//)              PRT10680
390 FORMAT (1HO,40X,I4,2X,27H*** XI-J ELEMENTS FOR PANEL,I3,3H***)    PRT10690
430 FORMAT (1HO,25X,38HEND OF PART1 - BASIC DATA CALCULATIONS)       PRT10700
440 FORMAT (1H1)                                                      PRT10710
    NT5  = 5                                                          PRT10720
    PI = 3.1415926                                                    PRT10730
    PI02  =  1.57                                                     PRT10740
450 DO 460  I = 1, 50                                                 PRT10750
    TH(I) = 0.                                                        PRT10760
    TAU(I)= 0.                                                        PRT10770
    GMA(I) = 0.                                                       PRT10780
    GMAS(I)= 0.0                                                      PRT10790
460 F(I) = 0.                                                         PRT10800
    DO 470  I = 1,400                                                 PRT10810
    X(I) = 0.                                                         PRT10820
    Y(I) = 0.                                                         PRT10830
    ZZ(I) = 0.                                                        PRT10840
    Z1(I)= 0.                                                         PRT10850
    Z2(I)= 0.                                                         PRT10860
    P1(I)= 0.                                                         PRT10970
    P2(I)= 0.                                                         PRT10880
    ZZ1(I)= 0.                                                        PRT10890
    ZZ2(I)= 0.                                                        PRT10900
    ZETA(I) = 0.                                                      PRT10910
    PNU(I) = 0.                                                       PRT10920
    ZEE(I)= 0.                                                        PRT10930
    EV(I) = 0.                                                        PRT10940
    PV(I) = 0.                                                        PRT10950
    ZV(I) = 0.                                                        PRT10960
    DELY(I) = 0.                                                      PRT10970
    SDELX(I) = 0.                                                     PRT10980
    DELZ(I) = 0.                                                      PRT10990
470 CONTINUF                                                          PRT11000
    DO 490   I = 1,50                                                 PRT11010
    FGAMMA(I)= 0.                                                     PRT11020
    YS(I)     = 0.                                                    PRT11030
    ZS(I)     = 0.                                                    PRT11040
    DELZS(I) = 0.                                                     PRT11050
    CWIG(I) = 0.0                                                     PRT11060
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  490 DELYS(I) = 0.                                                   PRT11070
      NSOFAR = 0                                                      PRT11080
      JBEGIN = 1                                                      PRT11090
      JCUM = 0                                                        PRT11100
C     *****                                                           PRT11110
C   *** REFSPN = B = B2 IS THE REFERENCE SEMI-SPAN ***                PRT11120
C   *** REFCHD = REFERENCE CHORD = FL IN PROG. CALC.                  PRT11130
      WRITE (6,40) FL, B2, ACAP, FMACH, BETA                          PRT11140
      SMALL = 0.0001                                                  PRT11150
      NSOFAR = 0                                                      PRT11160
      DO 630 LOOP = 1,NUPAN                                           PRT11170
      ILOOP = LOOP                                                    PRT11180
      WRITE (6,60) ILOOP                                              PRT11190
      READ (NT5,10) XCAP(1),XCAP(2),XCAP(3),XCAP(4),YCAP(1),YCAP(2)   PRT11200
      READ (NT5,25) ZCAP(1),ZCAP(2),NS,NC,COEFF                       PRT11210
      COEFP(ILOOP)=COEFF                                              PRT11220
      IF (COEFF.EQ.0.0)  COEFP(ILOOP)=1.0                             PRT11230
      X1 = XCAP(1)                                                    PRT11240
      X3 = XCAP(3)                                                    PRT11250
      Y1 = YCAP(1)                                                    PRT11260
      YIN(ILOOP)= Y1                                                  PRT11270
      Y2 = YCAP(2)                                                    PRT11280
      ZEE1 = ZCAP(1)                                                  PRT11290
      ZIN(ILOOP)= ZEE1                                                PRT11300
      ZEE2 = ZCAP(2)                                                  PRT11310
      CT1(ILOOP)= XCAP(2)-XCAP(1)                                     PRT11320
      CT2(ILOOP)= XCAP(4)-XCAP(3)                                     PRT11330
      WRITE (6,30) XCAP(1),XCAP(2),YCAP(1),ZCAP(1),XCAP(3),XCAP(4),YCAP(PRT11340
     12),ZCAP(2),NC,NS,NDELT,NOPAN                                    PRT11350
      NCNSM1 = (NC-1) * (NS-1)                                        PRT11360
      NCARAY(ILOOP) = NC                                              PRT11370
      NSARAY(ILOOP) = NS                                              PRT11380
      NCRUN = 1                                                       PRT11390
      NCEND = NC                                                      PRT11400
      NSRUN = 1                                                       PRT11410
      NSEND = NS                                                      PRT11420
C     INPUT CHORDWISE DIVISIONS *****                                 PRT11430
      READ (NT5, 10) (TH(I), I = 1,NC)                                PRT11440
C     INPUT SPANWISE DIVISIONS *****                                  PRT11450
      READ (NT5, 10) (TAU(I),I = 1,NS)                                PRT11460
  520 CONTINUE                                                        PRT11470
      WRITE (6,180) NC,ILOOP                                          PRT11480
      WRITE (6,170) (TH(I), I = NCRUN,NCEND)                          PRT11490
      WRITE (6,190) NS,ILOOP                                          PRT11500
      WRITE (6,170) (TAU(I), I = NSRUN,NSEND)                         PRT11510
  530 COEF = 1.0                                                      PRT11520
      YDIF   = YCAP(2) - YCAP(1)                                      PRT11530
      ZDIF   = ZCAP(2) - ZCAP(1)                                      PRT11540
      IF (ABS(YDIF).LT.SMALL) GO TO 540                               PRT11550
      CALL        ATAN3(ZDIF,YDIF,ATANA)                              PRT11560
      GMA(ILOOP) = ATANA                                              PRT11570
      GO TO 550                                                       PRT11580
  540 GMA(ILOOP) = PI/2.0                                             PRT11590
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      IF (ZDIF.LT.0.0) GMA(ILOOP)=-PI/2.0
  550 GMAS(ILOOP)=(GMA(ILOOP)*180.0)/PI
      FOUR = XCAP(4) - XCAP(3) - XCAP(2) + XCAP(1)
      DIFF31 = XCAP(3) - XCAP(1)
      DIFF21 = XCAP(2) - XCAP(1)
      DIFF43 = XCAP(4) - XCAP(3)
      DEL2 = DIFF43
      DEL1 = DIFF21
      DO 560 M = NCRUN,NCEND
      DO 560 N = NSRUN,NSEND
      J = M + NC * (N-1)
C ***
C   INDEX -J- EQUALS SUBSCRIPT(M,N)
C ***
      K =(M+1)   NC * (N-1)
C ***
C   INDEX -K- EQUALS SUBSCRIPT (M+1, N)
C ***
      L = M + NC * N
C ***
C   INDEX -L- EQUALS SUBSCRIPT (M, N+1)
C ***
      KL = (M+1) + NC * N
C ***
C   INDEX -KL- EQUALS SUBSCRIPT (M+1, N+1)
C ***
      ZETA(J)=COFF*(TAU(N)*((TH(M)*FOUR) +DIFF31) + TH(M)*DEL1 + X1)
      PNUP = YDIF*TAU(N)
      PNU(J) = Y1 + PNUP
      ZEEP = ZDIF*TAU(N)
      ZEE(J) = ZEEL + ZEEP
  560 CONTINUE
      JLIMIT = NC * NS
      LIM1 = 1
      LIM2 = JLIMIT
      J = JBEGIN
      DO 570 I = LIM1,LIM2,NC
      IPNC = I+NC
      XIJ(J) = (ZETA(I) + ZETA(IPNC)) / 2.
  570 J = J + 1
      WRITE (6,200) JLIMIT,ILOOP
      WRITE (6,170) (ZETA(I), I = LIM1,LIM2)
      WRITE (6,210) JLIMIT,ILOOP
      WRITE (6,170) ( PNU(I), I = LIM1,LIM2)
      WRITE (6,120) JLIMIT, ILOOP
      WRITE (6,170) (ZEE(I), I = LIM1,LIM2)
      JCOUNT = J - JBEGIN - 1
      JEND = J - 2
      WRITE (6,399) JCOUNT,ILOOP
      WRITE (6,170) (XIJ(I), I = JBEGIN,JEND)
      JBEGIN = JBEGIN + (NS-1)
  580 NCM1 = NCEND - 1
      NSM1 = NSEND - 1
      DO 590 M = NCRUN,NCM1
      DO 590 N = NSRUN,NSM1
      J = M + NC * (N-1)
      J1 = M + (NC-1) * (N-1) + NSOFAR
C ***
C   INDEX J1 USED TO DISTINGUISH (NC BY NS) ARRAYS FROM (NC-1)X(NS-1)A-S
C ***
C     FINAL ARRAY SINGLE DIMENSION VALUES ARE STORED BY COLUMNS
      K = (M+1) + NC * (N-1)
      L = M + NC * N
      KL = (M+1) + NC * N
      MJ = (M - 1) + NC*(N-1)
      KM = (M + 2) + NC*(N-1)
      X(J1)=(1. / 8.) * (ZETA(J) + 3. * ZETA(K) + 3. * ZETA(KL)+ZETA(L))
      Y(J1)= (1. / 2.) * (PNU(J) + PNU(L))
      ZZ(J1) = (ZEE(J)+ZEE(L))/2.
      Z1(J1)=(3./ 4.)* ZETA(J) + (1. / 4.) * ZETA(K)
      Z2(J1)=(3./ 4.)* ZETA(L) + (1. / 4.) * ZETA(KL)
      P1(J1)= PNU(J)
      P2(J1)= PNU(L)
      ZZ1(J1)= ZEE(J)
      ZZ2(J1)= ZEE(L)
      EV(J1)= (Z1(J1)+ Z2(J1))/ 2.
      PV(J1)= (P1(J1)+ P2(J1))/ 2.
      ZV(J1) = ZZ(J1)
      DELY(J1)= ABS( P2(J1)- P1(J1))
      DELZ(J1) = ABS(ZZ2(J1)-ZZ1(J1))
      FNUM = ZETA(K) + ZETA(KL) - ZETA(J) - ZETA(L)
      SDELX(J1)= FNUM / 2.
  590 CONTINUE
      J1 = JCUM + 1
      J2 = JCUM + NSM1
      KT    = 0
      M = NSOFAR + 1
      N = NSOFAR + NCM1
      JIX   = 0
      DO 620 J = J1,J2
      JIX   = JIX+1
      KT      = KT+1
      KTP1  = KT+1
      TS(J) =(TAU(KT)+TAU(KTP1))/2.0
      DO 600  I=M,N
      DELYS(J)= DELY(I)
      YS(J) = Y(I)
      DELZS(J)= DELZ(I)
      ZS(J) = ZZ(I)
  600 CMIG(J) = CMIG(J) + SDELX(I)
      DO 610  IC= M, N
  610 XDC(IC) = (EV(IC)-XIJ(J   ))/CMIG(J)
      M = N + 1
      FGAMMA(J)=GMA(ILOOP)
  620 N = N + NCM1
      M1 = NSOFAR + 1
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      NL = NSOFAR + NCML                                                PRT12660
      JCUM = J2                                                         PRT12670
      WRITE (6,330) ILOOP                                               PRT12680
      WRITE (6,170) (CWIG(I), I=J1,JCUM)                                PRT12690
  630 NSOFAR = NSOFAR + NCNSM1                                          PRT12700
      DO 640 JY = 1,NSOFAR                                              PRT12710
  640 DELY(JY) = SQRT(DELY(JY)**2 + DELZ(JY)**2)                        PRT12720
      NSW = JCUM                                                        PRT12730
      NBA  = 0                                                          PRT12740
      DO 660  IX = 1,NUPAN                                              PRT12750
      NBARAY(IX) = NBA +(NCARAY(IX)-1)* (NSARAY(IX)-1)                  PRT12760
  660 NBA = NBARAY(IX)                                                  PRT12770
      WRITE  (6,80) (NBARAY(IY), IY = 1,NOPAN)                          PRT12780
      WRITE (6,110) NOPAN                                               PRT12790
      WRITE (6,170) (GMAS(I),I=1,NOPAN)                                 PRT12800
  670 CONTINUE                                                          PRT12810
      JLIMIT = NSOFAR                                                   PRT12820
      NCNSM1 = NSOFAR                                                   PRT12830
      WRITE (6,220) NCNSM1                                              PRT12840
      WRITE (6,170) ( X(I),I=1,JLIMIT)                                  PRT12850
      WRITE (6,280) NCNSM1                                              PRT12860
      WRITE (6,170) (EV(I),I=1,JLIMIT)                                  PRT12870
      WRITE (6,240) NCNSM1                                              PRT12880
      WRITE (6,170) (Z1(I),I=1,JLIMIT)                                  PRT12890
      WRITE (6,250) NCNSM1                                              PRT12900
      WRITE (6,170) (Z2(I),I=1,JLIMIT)                                  PRT12910
      WRITE (6,230) NCNSM1                                              PRT12920
      WRITE (6,170) ( Y(I),I=1,JLIMIT)                                  PRT12930
      WRITE (6,290) NCNSM1                                              PRT12940
      WRITE (6,170) (PV(I),I=1,JLIMIT)                                  PRT12950
      WRITE (6,260) NCNSM1                                              PRT12960
      WRITE (6,170) (P1(I),I=1,JLIMIT)                                  PRT12970
      WRITE (6,270) NCNSM1                                              PRT12980
      WRITE (6,170) (P2(I),I=1,JLIMIT)                                  PRT12990
      WRITE (6,130) NCNSM1                                              PRT13000
      WRITE (6,170)  (ZZ(I), I = 1, JLIMIT)                             PRT13010
      WRITE (6,160) NCNSM1                                              PRT13020
      WRITE (6,170) (ZV(I) , I = 1, JLIMIT)                             PRT13030
      WRITE (6,140) NCNSM1                                              PRT13040
      WRITE (6,170) (ZZ1(I), I = 1, JLIMIT)                             PRT13050
      WRITE (6,150) NCNSM1                                              PRT13060
      WRITE (6,170) (ZZ2(I), I = 1, JLIMIT)                             PRT13070
      WRITE (6,320)                                                     PRT13080
      WRITE (6,170) (SDELX(I),I = 1,JLIMIT)                             PRT13090
      WRITE (6,170) (XOC(I), I=1,JLIMIT)                                PRT13100
      WRITE (6,300) NCNSM1                                              PRT13110
      WRITE (6,170) (DELY(I), I = 1,JLIMIT)                             PRT13120
      WRITE (6,350)  JCUM                                               PRT13130
      WRITE (6,170)  (YS(I), I = 1,JCUM)                                PRT13140
      WRITE (6,340)  JCUM                                               PRT13150
      WRITE (6,170)  (DELYS(I), I =1,JCUM)                              PRT13160
      WRITE (6,360)  JCUM                                               PRT13170
      WRITE (6,170) (ZS(I), I = 1,JCUM)                                 PRT13180
      WRITE (6,370)  JCUM                                               PRT13190
      WRITE (6,170)  (DELZS(I), I = 1,JCUM)                             PRT13200
      WRITE (6,170)(TS(I)  , I=1,JCUM)                                  PRT13210
      NBZ  = 0                                                          PRT13220
      NBY  = 0                                                          PRT13230
      NEZ  = 0                                                          PRT13240
      NEY  = 0                                                          PRT13250
  680 IF (NB .EQ. 0) GO TO 710                                          PRT13260
C    INPUT BODY GEOMETRY                                                PRT13270
      IY    = 0                                                         PRT13280
      NBOX = JLIMIT                                                     PRT13290
      I     = 0                                                         PRT13300
      IP1  = 0                                                          PRT13310
      KCUM = 0                                                          PRT13320
      JL1  = NBOX+1                                                     PRT13330
      KL1  = NBOX+1                                                     PRT13340
      DO 708  K=1,NB                                                    PRT13350
      READ  (5,35)  ZSC,YSC,NF,NZ,NY,COEFF,MRK(K,1),MRK(K,2)            PRT13360
      WRITE (6,45)  K, YSC, ZSC, NY, NZ, COEFF,MRK(K,1),MRK(K,2)        PRT13370
      IF (NZ.NE.0)  NBZ = NBZ+1                                         PRT13380
      IF (NY.NE.0) NBY = NBY+1                                          PRT13390
      NFM1 = NF-1                                                       PRT13400
      READ (NTS, 10) (F(I),  I = 1,NF)                                  PRT13410
      READ (NTS, 10) (RAD(I),I = 1,NF)                                  PRT13420
      WRITE (6,115) NF, K                                               PRT13430
      WRITE (6,170) ( F(I),  I = 1,NF)                                  PRT13440
      WRITE (6,125) NF, K                                               PRT13450
      WRITE (6,170) (RAD(I), I = 1,NF)                                  PRT13460
      BGMA(K) = 0.0                                                     PRT13470
      IF (NY.NE.0)  BGMA(K) = -PI/2.0                                   PRT13480
      IF (NZ.NE.0.AND.NY.NE.0)  BGMA(K) = 0.0                           PRT13490
      IF (NZ.EQ.0) GO TO 707                                            PRT13500
      NFZ(K) = NF                                                       PRT13510
      COEFB(K) = COEFF                                                  PRT13520
      IF (COEFF.EQ.0.0)  COEFB(K)=1.0                                   PRT13530
      GO TO 906                                                         PRT13540
  900 CONTINUE                                                          PRT13550
      IY    = IY+1                                                      PRT13560
      NFY(IY) = NF                                                      PRT13570
      DO 905 KY = 1,NF                                                  PRT13580
      FY(IY,KY) = F(KY)                                                 PRT13590
      RY(IY,KY) = RAD(KY)                                               PRT13600
  905 CONTINUE                                                          PRT13610
      GO TO 708                                                         PRT13620
  906 CONTINUE                                                          PRT13630
      I     = 0                                                         PRT13640
      IP1  = 0                                                          PRT13650
      JL2  = JL1 + NFM1 - 1                                             PRT13660
      KL2  = JL2                                                        PRT13670
      DO 700  J=JL1,JL2                                                 PRT13680
      KF    = J-NBOX                                                    PRT13690
      I     = I+1                                                       PRT13700
      IP1  = I+1                                                        PRT13710
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      X(J) = 0.5*(F(I) + F(IP1))                                        PRT13720
      EV(J)= X(J)                                                       PRT13730
      Y(J) = YSC                                                        PRT13740
      PY(J)= YSC                                                        PRT13750
      ZZ(J)= ZSC                                                        PRT13760
      ZV(J)= ZSC                                                        PRT13770
      SDELX(J)= ABS(F(IP1)-F(I))                                        PRT13780
      DELY(J) = 0.5*(RAD(I) + RAD(IP1))                                 PRT13790
      RO(KF)  = DELY(J)                                                 PRT13800
      ROP(KF) = (RAD(IP1) - RAD(I))/SDELX(J)                            PRT13810
  700 CONTINUE                                                          PRT13820
      JL1   = JL2+1                                                     PRT13830
      KCUM = KCUM + NFM1                                                PRT13840
      NBEA(K) = KCUM                                                    PRT13850
  707 CONTINUE                                                          PRT13860
      IF (NY.NE.0)   GO TO 900                                          PRT13870
  708 CONTINUE                                                          PRT13880
      IF (NAY.EQ.0)   GO TO 992                                         PRT13890
      DO 990 K=1,NBY                                                    PRT13900
      NF    = NFY(K)                                                    PRT13910
      DO 920 I=1,NF                                                     PRT13920
      F(I)   = FY(K,I)                                                  PRT13930
      RAD(I)= RY(K,I)                                                   PRT13940
  920 CONTINUE                                                          PRT13950
      JL2   = JL1+NFM1-1                                                PRT13960
      KL2   = JL2                                                       PRT13970
      I     = 0                                                         PRT13980
      IP1   = 0                                                         PRT13990
      DO 930 J=JL1,JL2                                                  PRT14000
      KF    = J-NBOX                                                    PRT14010
      I    = I+1                                                        PRT14020
      IP1   = I+1                                                       PRT14030
      X(J) = 0.5*(F(I) + F(IP1))                                        PRT14040
      EV(J)= X(J)                                                       PRT14050
      Y(J) = YSC                                                        PRT14060
      PY(J)= YSC                                                        PRT14070
      ZZ(J)= ZSC                                                        PRT14080
      ZV(J)= ZSC                                                        PRT14090
      SDELX(J)= F(IP1) - F(I)                                           PRT14100
      DELY(J) = 0.5*(RAD(I) + RAD(IP1))                                 PRT14110
      RO(KF)  = DELY(J)                                                 PRT14120
      ROP(KF) = (RAD(IP1) - RAD(I))/SDELX(J)                            PRT14130
  930 CONTINUE                                                          PRT14140
      JL1   = JL2+1                                                     PRT14150
      KCUM = KCUM + NFM1                                                PRT14160
      NBEA(K) = KCUM                                                    PRT14170
  990 CONTINUE                                                          PRT14180
  992 CONTINUE                                                          PRT14190
      WRITE (6,135)   KCUM                                              PRT14200
      WRITE (6,170) (X( KL),      KL=KL1,KL2)                           PRT14210
      WRITE (6,145)   KCUM                                              PRT14220
      WRITE (6,170) (EV(KL),      KL=KL1,KL2)                           PRT14230
      WRITE (6,155)   KCUM                                              PRT14240
      WRITE (6,170) (Y( KL),      KL=KL1,KL2)                           PRT14250
      WRITE (6,165)   KCUM                                              PRT14260
      WRITE (6,170) (ZZ(KL),      KL=KL1,KL2)                           PRT14270
      WRITE (6,175)   KCUM                                              PRT14280
      WRITE (6,170) (SDELX(KL), KL=KL1,KL2)                             PRT14290
      WRITE (6,185)   KCUM                                              PRT14300
      WRITE (6,170) (DELY(KL),  KL=KL1,KL2)                             PRT14310
  711 WRITE (6,430)                                                     PRT14320
      NCNSNT = JLIMIT                                                   PRT14330
      WRITE (6,440)                                                     PRT14340
  720 RETURN                                                            PRT14350
      END                                                               PRT14360
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                                                                     01/15/71
         GENB        -  EFN   SOURCE STATEMENT  -  IFN(S)  -

      SUBROUTINEGENB(EVA,DELX,DELY,XA,NSTRIP,BETA,IMX,NPC,NP,NSARAY,LIM)GENB0010
      DIMENSION EV(400),SDELX(400),DELY(400),X(400),EVA(400),XA(400),   GENB0020
     1          DELX(400),LIM(50,3),NSIZB(50,2),B(10,30),XLIM(50,3),    GENB0030
     2          XISLCT(50,10),XH(50,7)                                  GENB0040
      COMMON /YZY/    X1A(50), X3A(50), X5A(50),X7A(50),X2A(5C)         GENB0050
      COMMON  /P1GM/  CT1(20),CT2(20),TS(50)                            GENB0060
      COMMON  /NTPS/  NTP1,NTP2,NTP3,NTP4,NTP5,NTP6,NTP7,NTP8,NTP9,NTP10GENB0065
      DIMENSION  NSARAY(20),NOP(20),IS(20,7),XHI(20,7),XHO(2C,7)        GENB0070
      DIMENSION  X4A(50), X6A(50)                                       GENB0080
    5 FORMAT (1H1,15X, 29H ** B MATRIX ELEMENTS FOR THE,I4, 8H  STRIPS, GENB0090
     1 I4, 10H  BOXES **//3X, 9HSTRIP NO.,3X,7HBOX NO., 3X,32H  B ELEMENGENB0100
     2TS FOR MODES 1 THROUGH, I4/)                                      GENB0110
    7 FORMAT (1H0,18X,21H ** XH ARRAYS FOR THE, I4,11H  STRIPS **//7X,  GENB0120
     1 4HXH-1,12X,4HXH-2,12X,4HXH-3,12X,4HXH-4, 12X,4HXH-5,12X,4HXH-6,  GENB0130
     2 12X, 4HXH-7/)                                                    GENB0140
    9 FORMAT (1H0,7F16.6)                                               GENB0150
   10 FORMAT (1H0,5X,I4,6X,I4,6E16.6)                                   GENB0160
   20 FORMAT  (1H0,5X,6F16.8/)                                          GENB0170
   25 FORMAT  (6F10.0)                                                  GENB0180
   35 FORMAT  (6(1X,I2,7I1))                                            GENB0190
   55 FORMAT  (1X,3I3,1X,3I3,I15,I5,1X,2I3)                             GENB0200
C** EV- 1/4 CHORD X COORDINATE OF EACH BOX                              GENB0210
C** SDELX- AVERAGE CHORD LENGTH OF EACH BOX                             GENB0220
C** DELY- WIDTH OF EACH BOX                                             GENB0230
C** NSTRIP- NUMBER OF STREAMWISE STRIPS FOR INTEGRATION OF PRESSURES    GENB0240
C**          PRESSURES ARE INTEGRATED CHORDWISE , NOT SPANWISE          GENB0250
C** LIM- BOX LIMITS CORRESPONDING TO STRIP                              GENB0260
C** ISLCT- AERO DEGREE OF FREEDOM SELECTOR  OPTION 1                    GENB0270
C** B- INTEGRATION MATRIX                                               GENB0280
      IMX = 2                                                           GENB0330
      DO 30    I = 1,50                                                 GENB0340
      X1A(I)  = 0.                                                      GENB0350
      X2A(I)  = 0.                                                      GENB0360
      X3A(I)  = 0.                                                      GENB0370
      X4A(I)  = 0.                                                      GENB0380
      X6A(I)  = 0.                                                      GENB0390
      X7A(I)  = 0.                                                      GENB0400
   30 X5A(I)  = 0.                                                      GENB0410
      DO 40  I = 1,400                                                  GENB0420
      X(I) = XA(I)                                                      GENB0430
      EV(I) = EVA(I)                                                    GENB0440
   40 SDELX(I) = DELX(I)                                                GENB0450
      READ (NTP5,35) (NOP(I),IS(I,1),IS(I,2),IS(I,3),IS(I,4),IS(I,5),   GENB0460
     1               IS(I,6),IS(I,7) , I=1,NP)                          GENB0470     27
      NBOX = LIM(NSTRIP,2)                                              GENB0480
      DO 42  I = 1,NP                                                   GENB0490
      READ (NTP5, 25) (XHI(I,J), J = 1,6)                               GENB0500     45
      READ (NTP5, 25) (XHO(I,J), J = 1,6)                               GENB0510     50
   42 CONTINUE                                                          GENB0520
      WRITE (6,9) (CT1(K),  K=1,NP)                                     GENB0530     57
      WRITE (6,9) (CT2(K),  K=1,NP)                                     GENB0540     64
      WRITE (6,9) (TS(I), I=1,NSTRIP)                                   GENB0550     71
      DO 49  J = 1,7                                                    GENB0560
      K      = 1                                                        GENB0570
      NSAC   = NSARAY(1)-1                                              GENB0580
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GENB          - EFN   SOURCE STATEMENT  -  IFN(S)  -                 01/15/71

      DO 67  I = 1,NSTRIP                                              GENB0590
      DENOM  = (CT2(K)-CT1(K))*TS(I) + CT1(K)                          GENB0600
      XMF(I,J)=(XAMDA(K,J)*CT2(K) - XM1(K,J)*CT1(K))*TS(I) + XM1(K,J)* GENB0610
     1          CT1(K))/DENOM                                          GENB0620
      XISLCT(I,J)=FLOAT(ISL(K,J))                                      GENB0630
      IF (I.LT.NSAC)  GO TO 66                                         GENB0640
      K      = K+1                                                     GENB0650
      NSAC   = NSAC+NSARAY(K)-1                                        GENB0660
   66 CONTINUE                                                         GENB0670
   67 CONTINUE                                                         GENB0680
      WRITE (6,99) (XMF(I,J ), (I=1,NSTRIP)                            GENB0690      104
   60 CONTINUE                                                         GENB0700
      DO 70  I = 1,NSTRIP                                              GENB0710
      IR = 0                                                           GENB0720
      DO 68  J = 1,7                                                   GENB0730
      IF (XISLCT(I,J) .GT. 0.) IR = IR + 1                             GENB0740
   68 CONTINUE                                                         GENB0750
      NSIZE(I,1) = IR                                                  GENB0760
      NSIZE(I,2) = LIM(I,2) - LIM(I,1) + 1                             GENB0770
   70 CONTINUE                                                         GENB0780
      REWIND  NTP10                                                    GENB0790      129
      WRITE(NTP10)NSTRIP,NSIZE,LIM,XISLCT, XM,  X, SDELX               GENB0800      130
      DO 410  I = 1,NSTRIP                                             GENB0810
      IR = 0                                                           GENB0820
      LIM1 =  LIM(I,1)                                                 GENB0830
      LIM2 =  LIM(I,2)                                                 GENB0840
      CHORD = 0.                                                       GENB0850
      DO 80  L = LIM1,LIM2                                             GENB0860
   80 CHORD = CHORD + SDELX(L)                                         GENB0870
      XLE = EV(LIM1)- .5* SDELX(LIM1)                                  GENB0880
      X1 = XLE + XM(I,1) * CHORD                                       GENB0890
      X1A(I)   = X1                                                    GENB0900
      X2 = XLE + XM(I,2) * CHORD                                       GENB0910
      X2A(I)   = X2                                                    GENB0920
      X3 = XLE + XM(I,3) * CHORD                                       GENB0930
      X3A(I)   = X3                                                    GENB0940
      X4 = XLE + XM(I,4) * CHORD                                       GENB0950
      X4A(I)   = X4                                                    GENB0960
      X5 = XLE + XM(I,5) * CHORD                                       GENB0970
      X5A(I)   = X5                                                    GENB0980
      X6 = XLE + XM(I,6) * CHORD                                       GENB0990
      X6A(I)   = X6                                                    GENB1000
      X7 = XLE + XM(I,7) * CHORD                                       GENB1010
      X7A(I)   = X7                                                    GENB1020
      DO 90  II = 1,10                                                 GENB1030
      DO 90  JJ = 1,30                                                 GENB1040
   90 B(II,JJ) = 0.                                                    GENB1050
      DO 400  J = 1,7                                                  GENB1060
      IF (XISLCT (I,J) .LE. 0.)  GO TO 400                             GENB1070
      IR =IR + 1                                                       GENB1080
      IF (IR.GT.IMX) IMX = IR                                          GENB1090
      IF (NPC.NE.0)  GO TO 220                                         GENB1100
      GO TO (100,120,140,160,180,200,400,400), J                       GENB1110
  100 DO 110  L = LIM1,LIM2                                            GENB1120
      IC = L - LIM1 + 1                                                GENB1130
  110 B(IR,IC) = SDELX(L) * DELY(L)                                    GENB1140
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GENB          - EFN   SOURCE STATEMENT  -  IFN(S)  -                 01/15/71

      GO TO 400                                                        GENB1150
  120 DO 130  L = LIM1,LIM2                                            GENB1160
      IC =  L - LIM1 + 1                                               GENB1170
  130 B(IR,IC) = (EV(L) - X1) * SDELX(L)* DELY(L)                      GENB1180
      GO TO 400                                                        GENB1190
  140 DO 150  L = LIM1,LIM2                                            GENB1200
      IC =  L - LIM1 + 1                                               GENB1210
      IF (EV(L)     .LT. X2) GO TO 150                                 GENB1220
      B(IR,IC) = (EV(L) - X3) * SDELX(L) * DELY(L)                     GENB1230
  150 CONTINUE                                                         GENB1240
      GO TO 400                                                        GENB1250
  160 DO 170  L = LIM1,LIM2                                            GENB1260
      IC =  L - LIM1 + 1                                               GENB1270
      IF (EV(L) .LT. X4)  GO TO 170                                    GENB1280
      B(IR,IC) = (EV(L) - X5) * SDELX(L) * DELY(L)                     GENB1290
  170 CONTINUE                                                         GENB1300
      GO TO 400                                                        GENB1310
  180 DO 190  L = LIM1,LIM2                                            GENB1320
      IC =  L - LIM1 + 1                                               GENB1330
      IF (EV(L) .LT. X2 ) GO TO 190                                    GENB1340
      B(IR,IC) = SDELX(L)* DELY(L)                                     GENB1350
  190 CONTINUE                                                         GENB1360
      GO TO 400                                                        GENB1370
  200 DO 210 L = LIM1,LIM2                                             GENB1380
      IC =  L - LIM1 + 1                                               GENB1390
      IF (EV(L) .LT. X4) GO TO 210                                     GENB1400
      B(IR,IC) = SDELX(L) * DELY(L)                                    GENB1410
  210 CONTINUE                                                         GENB1420
      GO TO  400                                                       GENB1430
  220 CONTINUE                                                         GENB1440
      GO TO (230,260,290,320,340,360,380,400), J                       GENB1450
  230 DO 250  L = LIM1,LIM2                                            GENB1460
      IC =  L - LIM1 + 1                                               GENB1470
      TOP1  =(EV(L)-X2) *(EV(L)-X3)                                    GENB1480
      BOT   = (X1 - X2) * (X1 - X3)                                    GENB1490
      IF (NPC.EQ.0) BOT = 1.0                                          GENB1500
      IF (XISLCT(I,4).NE.0.0.AND.X(L).GT.X4)  GO TO 240                GENB1510
      B(IR,IC) = (TOP1/BOT)*SDELX(L)*DELY(L)                           GENB1520
      GO TO 250                                                        GENB1530
  240 CONTINUE                                                         GENB1540
      D     = ((X5-X2) * (X5-X3))/BOT                                  GENB1550
      DELTA= ((X5-X2) + (X5-X3))/BOT                                   GENB1560
      B(IR,IC) = (D + DELTA*(EV(L)-X5))*SDELX(L)*DELY(L)               GENB1570
  250 CONTINUE                                                         GENB1580
      GO TO 400                                                        GENB1590
  260 DO 280  L = LIM1,LIM2                                            GENB1600
      IC =  L - LIM1 + 1                                               GENB1610
      TOP1  =(EV(L)-X1) *(EV(L)-X3)                                    GENB1620
      BOT   = (X2 - X1) * (X2 - X3)                                    GENB1630
      IF (NPC.EQ.0) BOT = 1.0                                          GENB1640
      IF (XISLCT(I,4).NE.0.0.AND.X(L).GT.X4)  GO TO 270                GENB1650
      B(IR,IC) = (TOP1/BOT)*SDELX(L)*DELY(L)                           GENB1660
      GO TO 280                                                        GENB1670
  270 CONTINUE                                                         GENB1680
      D     = ((X5-X1) * (X5-X3))/BOT                                  GENB1690
      DELTA= ((X5-X1) + (X5-X3))/BOT                                   GENB1700
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      GENB         - EFN    SOURCE STATEMENT  -  IFN(S)  -                 01/15/71

      B(IR,IC) = (D + DELTA*(EV(L)-X5))*SDELX(L)*DELY(L)                   GENB1710
  280 CONTINUE                                                             GENB1720
      G. TO 400                                                            GENB1730
  290 DO 310  L = LIM1,LIM2                                                GENB1740
      IC =  L - LIM1 + 1                                                   GENB1750
      TOPI  =(EV(L)-X1) *(EV(L)-X2)                                        GENB1760
      BOT   = (X3 - X1) * (X3 - X2)                                        GENB1770
      IF (NPC.EQ.0) BOT = 1.0                                              GENB1780
      IF (XISLCT(I,4).NE.0.0.AND.X(L).GT.X4)  GO TO 300                    GENB1790
      B(IR,IC) = (TOPI/BOT)*SDELX(L)*DELY(L)                               GENB1800
      GO TO 310                                                            GENB1810
  300 CONTINUE                                                             GENB1820
      D     = ((X5-X1) * (X5-X2))/BOT                                      GENB1830
      DELTA= ((X5-X1) + (X5-X2))/BOT                                       GENB1840
      B(IR,IC) = (D + DELTA*(EV(L)-X5))*SDELX(L)*DELY(L)                   GENB1850
  310 CONTINUE                                                             GENB1860
      GO TO 400                                                            GENB1870
  320 DO 330  L = LIM1,LIM2                                                GENB1880
      IC =  L - LIM1 +1                                                    GENB1890
      IF (EV(L). LT .X4) GO TO  330                                        GENB1900
      B(IR,IC) = (EV(L) - X5) * SDELX(L)* DELY(L)                          GENB1910
  330 CONTINUE                                                             GENB1920
      GO TO  400                                                           GENB1930
  340 DO 350  L = LIM1,LIM2                                                GENB1940
      IC =  L - LIM1 + 1                                                   GENB1950
      IF (EV(L). LT .X6) GO TO  350                                        GENB1960
      B(IR,IC) = (EV(L) - X7) * SDELX(L)* DELY(L)                          GENB1970
  350 CONTINUE                                                             GENB1980
      GO TO  400                                                           GENB1990
  360 DO 370  L = LIM1,LIM2                                                GENB2000
      IC =  L - LIM1 + 1                                                   GENB2010
      IF (EV(L). LT .X4) GO TO  370                                        GENB2020
      B(IR,IC) = SDELX(L)*DELY(L)                                          GENB2030
  370 CONTINUE                                                             GENB2040
      GO TO  400                                                           GENB2050
  380 DO 390  L = LIM1,LIM2                                                GENB2060
      IC =  L - LIM1 + 1                                                   GENB2070
      IF (EV(L). LT .X6) GO TO  390                                        GENB2080
      B(IR,IC) = SDELX(L)*DELY(L)                                          GENB2090
  390 CONTINUE                                                             GENB2100
  400 CONTINUE                                                             GENB2110
      IF (I.EQ.1) WRITE(6,5) NSTRIP, NBOX, IMX                             GENB2120   400
      DO 405 L = LIM1,LIM2                                                 GENB2130
      LB  =  L - LIM1 + 1                                                  GENB2140
      DO 405 J = 1,IMX,3                                                   GENB2150
      JP1 =  J+1                                                           GENB2160
      JP2 =  J+2                                                           GENB2170
      WRITE (6,10) I,L, B(J,LB), B(JP1,LB), B(JP2,LB)                      GENB2180   408
  405 CONTINUE                                                             GENB2190
      WRITE (NTP10)  B                                                     GENB2200   414
  410 CONTINUE                                                             GENB2210
      WRITE (6, 7)  NSTRIP                                                 GENB2220   418
      DO 415 K = 1,NSTRIP                                                  GENB2230
  415 WRITE (6, 9)  X1A(K), X2A(K),X3A(K),X4A(K),X5A(K),X6A(K),X7A(K)      GENB2240   423
  420 RETURN                                                               GENB2250
      END                                                                  GENB2260
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      GENM         - EFN    SOURCE STATEMENT  -  IFN(S)  -                 01/15/71

      SUBROUTINE GENM(KRDBR,NCSFTO,NPC,NGUST,WG,GZRO,XZRO)                 GENM0010
      REAL KRDBR                                                           GENM0020
      COMMON /XYZ/YS(50),DELYS(50),ZS(50),DELZS(50),FGAMMA(50),CWIG(50)    GENM0030
      COMMON  /NTPS/  NTP1,NTP2,NTP3,NTP4,NTP5,NTP6,NTP7,NTP8,NTP9,NTP10   GENM0035
      DIMENSION LIM(50,3),NSIZB(50,2),XISLCT(50,10),XM(50,7),SDELX(400),   GENM0040
     1              X(400)                                                 GENM0050
      COMPLEX       W(30,10),GRHS(400)                                     GENM0060
    5 FORMAT (1H1,15X, 29H ** W MATRIX ELEMENTS FOR THE, I4, 6H  STRIPS,   GENM0070
     1 I4, 10H  BOXES **//3X, 9HSTRIP NO.,3X,7HBOX NO., 3X,32H  W ELEMEN   GENM0080
     2TS FOR MODES 1 THROUGH, I4/)                                         GENM0090
   10 FORMAT (1H0, 5X,I4,6X,I4,6E16.6)                                     GENM0100
   15 FORMAT (1H1,20X, 33H ** GUST RIGHT-HAND-SIDES FOR THE,I4, 9H BOXES   GENM0110
     1 **//)                                                               GENM0120
   17 FORMAT (1H0,6E20.6)                                                  GENM0130
   20 FORMAT (1H0,25X, 14HGAMMAS FOR THE, I3, 7H STRIPS/)                  GENM0140
   30 FORMAT (1H0,25X,F10.6/)                                              GENM0150
   40 FORMAT (6F10.0)                                                      GENM0160
      DO 60  I = 1,400                                                     GENM0170
   60 GRHS(I)  = 0.                                                        GENM0180
      NBOX = NCSFTO                                                        GENM0190
      REWIND  NTP10                                                        GENM0200     9
      READ (NTP10)  NSTRIP,NSIZB,LIM,XISLCT,XM,X,SDELX                     GENM0210    10
      REWIND  NTP3                                                         GENM0220    18
      IF (NGUST.EQ.0) GO TO 80                                             GENM0230
      WRITE (6,20) NSTRIP                                                  GENM0240    21
      J = 1                                                                GENM0250
      CGZNG = COS(GZRO - FGAMMA(J))                                        GENM0260    24
      DO 70  I = 1,NCSFTO                                                  GENM0270
      GRHSR   =  WG*COS(KRDBR*(X(I)-XZRO))                                 GENM0280    29
      GRHSI   = -WG*SIN(KRDBR*(X(I)-XZRO))                                 GENM0290    31
      GRHS(I) = (CMPLX(GRHSR,GRHSI))*CGZNG                                 GENM0300
      IF (I.NE.LIM(J,2)) GO TO 70                                          GENM0310
      J = J+1                                                              GENM0320
      CGZNG = COS(GZRO - FGAMMA(J))                                        GENM0330    39
      WRITE (6,30) FGAMMA(J)                                               GENM0340    40
   70 CONTINUE                                                             GENM0350
      WRITE (6,15) NBOX                                                    GENM0360    44
      WRITE (6,17) (GRHS(I), I=1,NBOX)                                     GENM0370    45
      WRITE (NTP3)  GRHS                                                   GENM0380    52
   80 CONTINUE                                                             GENM0390
      DO 470  I = 1,NSTRIP                                                 GENM0400
      IC = 0                                                               GENM0410
      DO 90 II = 1,30                                                      GENM0420
      DO 90 JJ = 1,10                                                      GENM0430
   90 W(II,JJ) = (0.0,0.0)                                                 GENM0440
      CHORD = 0.                                                           GENM0450
      LIM1  = LIM(I,1)                                                     GENM0460
      LIM2  = LIM(I,2)                                                     GENM0470
      DO 100  L = LIM1,LIM2                                                GENM0480
  100 CHORD = CHORD + SDELX(L)                                             GENM0490
      XLE    = X(LIM1)-.75*SDELX(LIM1)                                     GENM0500
      X1     = XLE + XM(I,1) * CHORD                                       GENM0510
      X2     = XLE + XM(I,2) * CHORD                                       GENM0520
      X3     = XLE + XM(I,3) * CHORD                                       GENM0530
      X4     = XLE + XM(I,4) * CHORD                                       GENM0540
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      X5    = XLE + XH(I,5) * CHORD                                GENW0550
      X6    = XLE + XH(I,6) * CHORD                                GENW0560
      X7    = XLE + XH(I,7) * CHORD                                GENW0570
      IF (NPC.EQ.0) GO TO 11C                                      GENW0580
      BOT1  = (X1 - X2) * (X1 - X3)                                GENW0590
      BOT2  = (X2 - X1) * (X2 - X3)                                GENW0600
      BOT3 = (X3 - X1) * (X3 - X2)                                 GENW0610
      GO TO 120                                                    GENW0620
  110 BOT1 = 1.                                                    GENW0630
      BOT2 = 1.                                                    GENW0640
      BOT3 = 1.                                                    GENW0650
  120 CONTINUE                                                     GENW0660
      IC    = 0                                                    GENW0670
      DO 460  J = 1,8                                              GENW0680
      IF (XISLCT(I,J).LE.0.0) GO TO 460                            GENW0690
      IC = IC + 1                                                  GENW0700
      IF (NPC.NE.0) GO TO 250                                      GENW0710
      GO TO (130,150,170,190,210,230,460,460), J                   GENW0720
  13C DO 14C L = LIM1,LIM2                                         GENW0730
      IR = L - LIM1 + 1                                            GENW0740
  140 W(IR,IC) = CMPLX(0.0,KRDBR)                                  GENW0750
      GO TO 460                                                    GENW0760
  150 DO 160 L = LIM1,LIM2                                         GENW0770
      IR = L - LIM1 + 1                                            GENW0780
  160 W(IR,IC) = CMPLX(1.0,KRDBR*(X(L)-X1))                        GENW0790
      GO TO 460                                                    GENW0800
  170 DO 180 L = LIM1,LIM2                                         GENW0810
      IR = L - LIM1 + 1                                            GENW0820
      IF (X(L).LT.X2) GO TO 180                                    GENW0830
      W(IR,IC) = CMPLX(1.0,KRDBR*(X(L)-X3))                        GENW0840
  180 CONTINUE                                                     GENW0850
      GO TO 460                                                    GENW0860
  190 DO 200 L = LIM1,LIM2                                         GENW0870
      IR = L - LIM1 + 1                                            GENW0880
      IF (X(L).LT.X4) GO TO 200                                    GENW0890
      W(IR,IC) = CMPLX(1.0,KRDBR*(X(L)-X5))                        GENW0900
  200 CONTINUE                                                     GENW0910
      GO TO  460                                                   GENW0920
  210 DO 220 L = LIM1,LIM2                                         GENW0930
      IR = L - LIM1 + 1                                            GENW0940
      IF (X(L).LT.X2) GO TO 220                                    GENW0950
      W(IR,IC) = CMPLX(0.0,KRDBR)                                  GENW0960
  220 CONTINUE                                                     GENW0970
      GO TO 460                                                    GENW0980
  230 DO 24C L = LIM1,LIM2                                         GENW0990
      IR = L - LIM1 + 1                                            GENW1000
      IF (X(L).LT.X4) GO TO 240                                    GENW1010
      W(IR,IC) = CMPLX(0.0,KRDBR)                                  GENW1020
  240 CONTINUE                                                     GENW1030
      GO TO 460                                                    GENW1040
  250 CONTINUE                                                     GENW1050
      GO TO (260,300,340,38C,400,420,440,460), J                   GENW1060
  260 DO 290 L = LIM1,LIM2                                         GENW1070
      IR = L - LIM1 + 1                                            GENW1080
      TOPR  = (X(L)-X2) + (X(L)-X3)                                GENW1090
      TOPI  = (X(L)-X2) * (X(L)-X3)                                GENW1100
```



```
      BOT   = BOT1                                                 GENW1110
      IF (XISLCT(I,4).NE.0.0.AND.X(L).GT.X4)  GO TO 270            GENW1120
      WRE   =  TOPR/BOT                                            GENW1130
      WIM   =  KRDBR*(TOPI/BOT)                                    GENW1140
      GO TO 280                                                    GENW1150
  270 D     = ((X5-X2) * (X5-X3))/BOT                              GENW1160
      DELTA= ((X5-X2) + (X5-X3))/BOT                               GENW1170
      WRE   = DELTA                                                GENW1180
      WIM   = KRDBR*(D + DELTA * (X(L)-X5))                        GENW1190
  280 W(IR,IC) = CMPLX(WRE,WIM)                                    GENW1200
  290 CONTINUE                                                     GENW1210
      GO TO 460                                                    GENW1220
  300 DO 330 L = LIM1,LIM2                                         GENW1230
      IR = L - LIM1 + 1                                            GENW1240
      TOPR  = (X(L)-X1) + (X(L)-X3)                                GENW1250
      TOPI  = (X(L)-X1) * (X(L)-X3)                                GENW1260
      BOT   = BOT2                                                 GENW1270
      IF (XISLCT(I,4).NE.0.0.AND.X(L).GT.X4)  GO TO 310            GENW1280
      WRE   =  TOPR/BOT                                            GENW1290
      WIM   =  KRDBR*(TOPI/BOT)                                    GENW1300
      GO TO 320                                                    GENW1310
  310 D     = ((X5-X1) * (X5-X3))/BOT                              GENW1320
      DELTA= ((X5-X1) + (X5-X3))/BOT                               GENW1330
      WRE   =  DELTA                                               GENW1340
      WIM   =  KRDBR*(D + DELTA*(X(L)-X5))                         GENW1350
  320 W(IR,IC) = CMPLX(WRE,WIM)                                    GENW1360
  330 CONTINUE                                                     GENW1370
      GO TO 460                                                    GENW1380
  340 DO 37C L = LIM1,LIM2                                         GENW1390
      IR = L - LIM1 + 1                                            GENW1400
      TOPR = (X(L)-X1) + (X(L)-X2)                                 GENW1410
      TOPI = (X(L)-X1) * (X(L)-X2)                                 GENW1420
      BOT   = BOT3                                                 GENW1430
      IF (XISLCT(I,4).NE.0.0.AND.X(L).GT.X4)  GO TO 350            GENW1440
      WRE   = TOPR/BOT                                             GENW1450
      WIM   = KRDBR*(TOPI/BOT)                                     GENW1460
      GO TO 360                                                    GENW1470
  350 D     = ((X5-X1) * (X5-X2))/BOT                              GENW1480
      DELTA= ((X5-X1) + (X5-X2))/BOT                               GENW1490
      WRE   = DELTA                                                GENW1500
      WIM   = KRDBR*(D + DELTA*(X(L)-X5))                          GENW1510
  360 W(IR,IC) = CMPLX(WRE,WIM)                                    GENW1520
  370 CONTINUE                                                     GENW1530
      GO TO 460                                                    GENW1540
  380 DO 390 L = LIM1,LIM2                                         GENW1550
      IR = L - LIM1 + 1                                            GENW1560
      IF (X(L).LT.X4) GO TO 390                                    GENW1570
      W(IR,IC) = CMPLX(1.0,KRDBR*(X(L)-X5))                        GENW1580
  390 CONTINUE                                                     GENW1590
      GO TO 460                                                    GENW1600
  400 DO 410 L = LIM1,LIM2                                         GENW1610
      IR = L - LIM1 + 1                                            GENW1620
      IF (X(L).LT.X6) GO TO 410                                    GENW1630
      W(IR,IC) = CMPLX(1.0,KRDBR*(X(L)-X7))                        GENW1640
  410 CONTINUE                                                     GENW1650
      GO TO 460                                                    GENW1660
```

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GENW       - EFN   SOURCE STATEMENT  -  IFN(S)  -                01/15/71

 420 DO 430 L = LIM1,LIM2                                        GENW1670
     IR = L - LIM1 + 1                                           GENW1680
     IF (X(L).LT.X0) GO TO 430                                   GENW1690
     W(IR,IC) = CMPLX(0.0,KRDBR)                                 GENW1700
 430 CONTINUE                                                    GENW1710
     GO TO 460                                                   GENW1720
 440 DO 450 L = LIM1,LIM2                                        GENW1730
     IR = L - LIM1 + 1                                           GENW1740
     IF (X(L).LT.X0) GO TO 450                                   GENW1750
     W(IR,IC) = CMPLX(0.0,KRDBR)                                 GENW1760
 450 CONTINUE                                                    GENW1770
 460 CONTINUE                                                    GENW1780
     IF (I.EQ.1) WRITE (6,5) NSTRIP, NBOX, IC                    GENW1790    284
     DO 465 L = LIM1,LIM2                                        GENW1800
     LW  =  L - LIM1+1                                           GENW1810
     DO 465 J = 1,IC,3                                           GENW1820
     JP1 =  J+1                                                  GENW1830
     JP2 =  J+2                                                  GENW1840
     WRITE (6,10) I,L, W(LW,J), W(LW,JP1), W(LW,JP2)             GENW1850    292
 465 CONTINUE                                                    GENW1860
     WRITE (NTP3)  W                                             GENW1870    298
 470 CONTINUE                                                    GENW1880
     RETURN                                                      GENW1890
     END                                                         GENW1900
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GENO       - EFN   SOURCE STATEMENT  -  IFN(S)  -                01/15/71

      SUBROUTINE GENO(NA,NS,NB,NRF,JRF,NBE,     NWD,NWTP,NWTB,NCORE,     GENO0010
     1           KBO2,YIN,ZIN,COEFP,COEFB)                               GENO0020
      COMMON  NCNSM1,NB,NOBLT,NDATA,NDPAN,I0,IR,JSPECS,FMACH,NCARAY(20), GENO0030
     1        NSARAY(20),NBARAY(20),ACAP,B2,FL,BETA,PI,KR,KRDBR,GMA(50), GENO0040
     2        X(400),Y(400),ZZ(400),Z1(400),P1(400),ZZ1(400),ZZ(400),    GENO0050
     3        P2(400),ZZ2(400),EV(400),PV(400),ZV(400),SDELX(300),       GENO0060
     4        DELY(400)                                                  GENO0070
      COMMON  /BODY/ RO( 80),ROP( 80),NBLA(20),BGMA(20),NNK(20,2)        GENO0080
      DIMENSION  NB(80),NARG(80),LARG(20,2),YIN(20),ZIN(20),COEFP(20),   GENO0090
     1           COEFB(20),ARG(120),BQ(400),H(400),DH1(400),DH2(400)     GENO0100
      COMMON  /MODE/ NB,NARG,LARG,ARG,H,DH1,DH2                          GENO0110
      COMPLEX     WB(400),             ASUM(400),WW(40)                  GENO0120
      REAL        KR,KRDBR                                               GENO0130
      COMMON/NTPS/ NTP1,NTP2,NTP3,NTP4,NTP5,NTP6,NTP7,NTP8,NTP9,NTP10    GENO0140
    5 FORMAT    (12I5)                                                   GENO0150
   10 FORMAT    (1H1,30X, 35HW MATRIX ELEMENTS FOR ALL BOXES    //)      GENO0160
   15 FORMAT    (6F10.0)                                                 GENO0170
   20 FORMAT    (1H0,5X,27HPANEL   MODE   N  M       ARG/)               GENO0180
   25 FORMAT    (1H0,4X,2I6,2I3,F12.4)                                   GENO0190
   27 FORMAT    (1H0,5X,I3,6E20.8)                                       GENO0200
   30 FORMAT    (6(4I2,2X))                                              GENO0210
   35 FORMAT    (3(2I2,6X,F10.0))                                        GENO0220
   40 FORMAT    (1H0,25X,5HTHE,I4,31H W-MATRIX ELEMENTS FOR MODE NO.,I4) GENO0230
   45 FORMAT    (1H0,6E17.8)                                             GENO0240
   50 FORMAT    (1H0,25X,5HTHE,I4,31H B-MATRIX ELEMENTS FOR MODE NO.,I4) GENO0250
      NP    = NDPAN                                                      GENO0260
      S     = B2                                                         GENO0270
      BR    = FL/2.0                                                     GENO0280
      M     = 5                                                          GENO0290
      N     = 5                                                          GENO0300
      IROW  = 1                                                          GENO0310
      IF (NB.NE.0.OR.NCORE.GT.KBO2.OR.NS.NE.0)  IROW=0                   GENO0320
      REWIND  NTP2                                                       GENO0330     7
      REWIND  NTP3                                                       GENO0340     8
      REWIND  NTP4                                                       GENO0350     9
      REWIND  NTP8                                                       GENO0360    10
      REWIND  NTP10                                                      GENO0370    11
      REWIND  NTP7                                                       GENO0380    12
      NTAPE=  7                                                          GENO0390
      REWIND  NTAPE                                                      GENO0400    13
      NBOX  = NCNSM1                                                     GENO0410
      NTOT  = NBOX+NBE                                                   GENO0420
      IF (NA.EQ.1)  READ (NTAPE)  NUMR                                   GENO0430    16
      IF (NA.EQ.2)  READ (5,  5)  NUMR                                   GENO0440    19
      IF (NA.NE.0.AND.NUMR.NE.NBOX)  STOP                                GENO0450
      NTPB  = NTP10                                                      GENO0460
      NTPW  = NTP4                                                       GENO0470
      I1    = 0                                                          GENO0480
      IF (NBE.EQ.0)  GO TO 51                                            GENO0490
      NTPB  = NTP2                                                       GENO0500
      NTPW  = NTP3                                                       GENO0510
      I1    = NNK(1,1)                                                   GENO0520
      DO  53  K=1,NP                                                     GENO0530
      IF (K.EQ.NP)  GO TO 53                                             GENO0540
      KP1   = K+1                                                        GENO0550
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     GENQ         - EFN   SOURCE STATEMENT  -  IFN(S)  -                01/13/71

      IF (MBAI(KP1,1).GE.MBAI(K,1))  GO TO 51                           GEN00560
      I1   = MBAI(KP1,1)                                                GEN00570
   51 CONTINUE                                                          GEN00580
   52 CONTINUE                                                          GEN00590
      IF (I1.EQ.0)   I1=NBOX+1                                          GEN00600
      I0P  = NBOX+1                                                     GEN00610
      I0L  = NTOT                                                       GEN00620
      IF (NQ.NE.0)   GO TO 89                                           GEN00630
      IF (NKP.GT.1.AND.JKP.GT.1)  GO TO 40                              GEN0064C
      DO  57  I=1,400                                                   GEN00650
      AQ(I)  = 0.0                                                      GEN00660
      BQ(I)  = (0.0,0.0)                                                GEN00670
      ASUM(I)= (0.0,0.0)                                                GEN00680
   57 CONTINUE                                                          GEN00690
      NMTO = [illegible]                                                GEN00700
      DO  56  K=1,NMTO,6                                                GEN00710
      KP1  = K+1                                                        GES00720
      KP2  = K+2                                                        GES00730
      KP3  = K+3                                                        GES00740
      KP4  = K+4                                                        GES00750
      KP5  = K+5                                                        GES00760
      READ  (5,10) [illegible]                                          GES00770
     1             [illegible]                                          GES00780
     2             [illegible]                                          GES00790      77
   56 CONTINUE                                                          GES00800
      DO  58  K=1,NMTP,3                                                GES00810
      KP1  = K+1                                                        GES00820
      KP2  = K+2                                                        GES00830
      READ  (5,90) LARG(K,  1),LARG(K,  2),ARG(K  ),                    GES00840
     1             LARG(KP1,1),LARG(KP1,2),ARG(KP1),                    GES00850
     2             LARG(KP2,1),LARG(KP2,2),ARG(KP2)                     GES00860     109
   58 CONTINUE                                                          GES00870
                                                                        GES00880
      WRITE (6,20)                                                      GES00890     121
      KK   = 0                                                          GES00900
      K    = 0                                                          GES00910
      DO  66  J=1,NMD                                                   GES00920
      DO  15  L=1,NP                                                    GES00930
      KK   = KK+1                                                       GES00940
      NQ   = NARQ(KK)                                                   GES00950
      IF (NQ.EQ.0)   GO TO 16                                           GES00960
      DO  17  I=1,NQ                                                    GES00970
      K    = K+1                                                        GES00980
      WRITE (6,25)  L,J,(LARG(K,1),LARG(K,2),ARG(K))                    GES00990     137
   17 CONTINUE                                                          GES01000
   16 CONTINUE                                                          GES01010
   15 CONTINUE                                                          GES01020
      GO TO  49                                                         GES01030
   40 CONTINUE                                                          GES01040
      REWIND  NTPQ                                                      GES01050     149
      DO  47  J=1,NMD                                                   GES01060
      READ  (NTPQ)                                                      GES01070     152
   47 CONTINUE                                                          GES01080
      READ  (NTPQ)  NQ,NARQ,LARQ,ARQ                                    GES01090     155
      IF (IROW.EQ.1)  GO TO 209                                         GES01100
   49 CONTINUE                                                          GES01110
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     GENQ         - EFN   SOURCE STATEMENT  -  IFN(S)  -                01/13/71

      NQ    = 0                                                         GES01120
      NK    = 0                                                         GES01130
      NKA   = 0                                                         GES01140
      NKB   = 0                                                         GES01150
      IF (IROW.EQ.0)  WRITE (NTPW)  NMD                                 GES01160     168
      DO 200  J=1,NMD                                                   GES01170
      IF (N6.EQ.0)   GO TO 89                                           GES01180
      GO TO  (87 ,88 ), N6                                              GES01190
   87 CONTINUE                                                          GES01200
      READ  (NTAPE)  (BQ(II),  II=1,NBOX)                               GES01210     177
      READ  (NTAPE)  (H(II),   II=1,NBOX)                               GES01220     182
      READ  (NTAPE)  (DHI(II), II=1,NBOX)                               GES01230     187
      GO TO  182                                                        GES01240
   88 CONTINUE                                                          GES01250
      READ  (5,15 )  (BQ(II),  II=1,NBOX)                               GES01260     193
      READ  (5, 15)  (H(II),   II=1,NBOX)                               GES01270     198
      READ  (5, 15)  (DHI(II), II=1,NBOX)                               GES01280     203
      GO TO  182                                                        GES01290
   89 CONTINUE                                                          GES01300
      I1    = 0                                                         GES01310
      I2    = 0                                                         GES01320
      DO 180  L=1,NP                                                    GES01330
      I1    = I2+1                                                      GES01340
      I2    = NBARAY(L)                                                 GES01350
      NK    = NK+1                                                      GES01360
      NP1   = N+1                                                       GES01370
      MP1   = M+1                                                       GES01380
      NQ    = NARQ(NK)                                                  GES01390
      NKA   = NKB+1                                                     GES01400
      NKB   = NKB+NQ                                                    GES01410
      DO 160  I=I1,I2                                                   GES01420
      XQ    = X(I)                                                      GES01430
      XQB   = X(I)-SDELX(I)/2.0                                         GES01440
      XOS   = XQ/S                                                      GES01450
      XOSB  = XQB/S                                                     GES01460
      Y1    = YIN(L)                                                    GES01470
      ZL    = ZIN(L)                                                    GES01480
      YQ    = Y(I)-Y1*FLOAT(NB(NK))                                     GES01490
      ZQ    =Z(I)-ZL*FLOAT(NB(NK))                                      GES01500
      T1    = SQRT(YQ*YQ + ZQ*ZQ)                                       GES01510     235
      TOS   = T1/S                                                      GES01520
      HPQI  = 0.0                                                       GES01530
      HPQIB= 0.0                                                        GES01540
      DHIX  = 0.0                                                       GES01550
      TOSM  = 1.0                                                       GES01560
      DO 140  JX=1,MP1                                                  GES01570
      XOSN  = 1.0                                                       GES01580
      XOSBN= 1.0                                                        GES01590
      XOSN1= 1.0                                                        GES01600
      DO 120  IX=1,NP1                                                  GES01610
      ARQNM= 0.0                                                        GES01620
      IF (NQ.EQ.0)   GO TO 100                                          GES01630
      DO  90 NKX=NKA,NKB                                                GES01640
      LN    = LARQ(NKX,1)+1                                             GES01650
      LM    = LARQ(NKX,2)+1                                             GES01660
      IF (LN.EQ.IX.AND.LM.EQ.JX)  ARQNM=ARQ(NKX)                        GES01670
```

```
   90 CONTINUE                                                        GESQ1680
  100 CONTINUE                                                        GESQ1690
      HPQI = HPQI  + COEFP(L)*ARQNM*XOSN *TOSN                        GESQ1700
      HPQIB= HPQIB + COEFP(L)*ARQNM*XOSBN*TOSN                        GESQ1710
      DHIX = DHIX  + COEFP(L)*ARQNM*XOSN1*TOSN*FLOAT(IX-1)            GESQ1720
      XOSN = XOSN*XOS                                                 GESQ1730
      XOSBN= XOSBN*XOSB                                               GESQ1740
      IF (IX.EQ.1)  GO TO 120                                         GESQ1750
      XOSN1= XOSN1*XOS                                                GESQ1760
  120 CONTINUE                                                        GESQ1770
      TOSN = TOSN*TOS                                                 GESQ1780
  140 CONTINUE                                                        GESQ1790
      DELAI = SDELX(I)*DELY(I)                                        GESQ1800
      AQ(I) = DELAI * HPQIB/(S*S)                                     GESQ1810
  145 CONTINUE                                                        GESQ1820
      IF (IROW.EQ.1)  GO TO 160                                       GESQ1830
      WRE    = DHIX                                                   GESQ1840
      WIM    = (HPQI*KR*S)/*R                                         GESQ1850
      WQ(I) = CMPLX(WRE,WIM)                                          GESQ1860
      IF (I.GE.II)  WQ(I)=(0.0,0.0)                                   GESQ1870
  160 CONTINUE                                                        GESQ1880
  150 CONTINUE                                                        GESQ1890
      IF (JRF.GT.1)  GO TO 185                                        GESQ1900
  182 CONTINUE                                                        GESQ1
      WRITE (5,50)  NBOX,J                                            GESQ.        283
      WRITE (6,45)  (BQ(I),  I=1,NBOX)                                GESQ1        284
      WRITE (NTPB)  (BQ(I),  I=1,NBOX)                                GESQ1        289
  185 CONTINUE                                                        GESQ19
      IF (NG.NE.0)  GO TO 186                                         GESQ1960
      IF (IROW.EQ.1)  GO TO 200                                       GESQ1970
      GO TO  188                                                      GESQ1980
  186 CONTINUE                                                        GESQ1990
      IF (J.EQ.1.AND.NB.EQ.0)  WRITE (NTPW)  NMO                      GENQ1995     303
      DO 187  IW=1,NBOX                                               GESQ2000
      WRE   = DHI(IW)                                                 GESQ2010
      WIM   = (HI(IW)*KR*S)/BR                                        GESQ2020
      WQ(IW) = CMPLX(WRE,WIM)                                         GESQ2030
  187 CONTINUE                                                        GESQ2040
  188 CONTINUE                                                        GESQ2050
      WRITE (6,40)  NBOX,J                                            GESQ2060     312
      WRITE (5,45)  (WQ(I),  I=1,NBOX)                                GESQ2070     313
      WRITE (NTPW)  (WQ(I),  I=1,NBOX)                                GESQ2080     318
  200 CONTINUE                                                        GESQ2090
      IF (NRF.GT.1.AND.JRF.EQ.1)  WRITE (NTPB) NB,NARG,LARQ,ARQ       GESQ2100     326
      IF (NG.NE.0)  GO TO 400                                         GESQ2110
      IF (IROW.EQ.0)  GO TO 400                                       GESQ2120
  205 CONTINUE                                                        GESQ2130
      NK    = 0                                                       GESQ2140
      NQ    = 0                                                       GESQ2150
      NKA   = 0                                                       GESQ2160
      NKB   = 0                                                       GESQ2170
      I1    = 0                                                       GESQ2180
      I2    = 0                                                       GESQ2190
      WRITE  (6,10)                                                   GESQ2200     344
      DO 300  L=1,NP                                                  GESQ2210
      I1    = I2+1                                                    GESQ2220
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```
      I2    = NBARAY(L)                                               GESQ2230
      DO 280  I=I1,I2                                                 GESQ2240
      XQ    = X(I)                                                    GESQ2250
      XOS   = XQ/S                                                    GESQ2260
      Y1    = YIN(L)                                                  GESQ2270
      ZL    = ZIN(L)                                                  GESQ2280
      DO 260  J=1,NMD                                                 GESQ2290
      NK    = L+NP*(J-1)                                              GESQ2300
      NQ    = NARQ(NK)                                                GESQ2310
      NKM1 = NK-1                                                     GESQ2320
      YQ    = Y(I)-Y1*FLOAT(NB(NK))                                   GESQ2330
      ZQ    =Z(I)-ZL*FLOAT(NB(NK))                                    GESQ2340
      TI    = SQRT(YQ*YQ + ZQ*ZQ)                                     GESQ2350     346
      TOS   = TI/S                                                    GESQ2360
      NKA   = 1                                                       GESQ2370
         195  NKRUN=1,NK                                              GESQ2380
      IF (NKRUN.EQ.1)  GO TO 195                                      GESQ2390
      NKRM1= NKRUN-1                                                  GENQ2395
      NKA   = NKA+NARQ(NKRM1)                                         GENQ2400
  195 CONTINUE                                                        GESQ2410
      NKB   = NKA+NQ-1                                                GESQ2420
      NM1   = N-1                                                     GESQ2430
      NP1   = N+1                                                     GESQ2440
      MP1   = M+1                                                     GESQ2450
      HPQI = 0.0                                                      GESQ2460
      DHIX = 0.0                                                      GESQ2470
      TOSN = 1.0                                                      GESQ2480
      DO 240  JX=1,MP1                                                GESQ2490
      XOSN = 1.0                                                      GESQ2500
      XOSN1= 1.0                                                      GESQ2310
      DO 220  IX=1,NP1                                                GESQ2520
      ARQNM= 0.0                                                      GESQ2530
      IF (NQ.EQ.0)  GO TO 197                                         GESQ2540
      DO 190 NKX=NKA,NKB                                              GESQ2550
      LN    = LARQ(NKX,1)+1                                           GESQ2560
      LM    = LARQ(NKX,2)+1                                           GESQ2570
      IF (LN.EQ.IX.AND.LM.EQ.JX)  ARQNM=ARQ(NKX)                      GESQ2580
  190 CONTINUE                                                        GESQ2590
  197 CONTINUE                                                        GESQ2600
      HPQI = HPQI  + COEFP(L)*ARQNM*XOSN *TOSN                        GESQ2610
      DHIX = DHIX  + COEFP(L)*ARQNM*XOSN1*TOSN*FLOAT(IX-1)            GESQ2620
      XOSN = XOSN*XOS                                                 GESQ2630
      IF (IX.EQ.1)  GO TO 220                                         GESQ2640
      XOSN1= XOSN1*XOS                                                GESQ2650
  220 CONTINUE                                                        GESQ2660
      TOSN = TOSN*TOS                                                 GESQ2670
  240 CONTINUE                                                        GESQ2680
      WRE    = DHIX                                                   GESQ2690
      WIM    = (HPQI*KR*S)/BR                                         GESQ2700
      WQ(J) = CMPLX(WRE,WIM)                                          GESQ2710
  260 CONTINUE                                                        GESQ2720
      DO 275  JW=1,NMD,3                                              GESQ2730
      JW1   = JW+1                                                    GESQ2740
      JW2   = JW+2                                                    GESQ2750
      WRITE (6,27)  I,WQ(JW),WQ(JW1),WQ(JW2)                          GESQ2760     415
  275 CONTINUE                                                        GESQ2770
```

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GENG          - EFN    SOURCE STATEMENT  -  IFN(S)  -                01/15/71

      WRITE (NTP3)  (WQ(J),  J=1,NMO)                                 GE5Q2780     420
  200 CONTINUE                                                        GE5Q2790
  300 CONTINUE                                                        GE5Q2800
      GO TO 770                                                       GE5Q2810
  400 CONTINUE                                                        GE5Q2820
      IF (NBE.EQ.0)  GO TO 700                                        GE5Q2830
      REWIND  NTP8                                                    GE5Q2840     434
      REWIND  NTP4                                                    GE5Q2850     435
      READ  (NTP4)  NMO                                               GE5Q2860     436
      DO 600  J=1,NMO                                                 GE5Q2870
      READ  (NTP8)  (BQ(I), I=1,NBOX)                                 GE5Q2880     440
      READ  (NTP4)  (WQ(I), I=1,NBOX)                                 GE5Q2890     445
      CALL        AUGW(NMO,NBOX,NBE,NMTB,N4,N6,NRF,JRF,J ,COEFB,ASUM) GE5Q2900     450
      DO 525  IX=1,NBOX                                               GE5Q2910
      WQ(IX) = WQ(IX) + ASUM(IX)                                      GE5Q2920
  525 CONTINUE                                                        GE5Q2930
      IF (J.EQ.1)  WRITE (NTP4)  NMO                                  GE5Q2940     459
      BACKSPACE  NTP8                                                 GE5Q2950     460
      READ  (NTP8)  (BQ(K), K=IBF,IBL)                                GE5Q2960     461
      WRITE (NTP4)  (WQ(I), I=1,NBOX)                                 GE5Q2970     466
      WRITE (NTP10) (BQ(I), I=1,NTOT)                                 GE5Q2980     471
  600 CONTINUE                                                        GE5Q2990
      IF (NCORE.GT.ADD2.OR.N5.NE.C)  GO TO 770                        GE5Q3000
      NTP4 = NTP4                                                     GE5Q3010
  700 CONTINUE                                                        GE5Q3020
      REWIND  NTP3                                                    GE5Q3030     482
      DO 720  I=1,NBOX                                                GE5Q3040
      REWIND  NTP4                                                    GE5Q3050     485
      READ  (NTP4)  NMO                                               GE5Q3060     486
      DO 710  J=1,NMO                                                 GE5Q3070
      READ  (NTP4)  (WQ(K), K=1,NBOX)                                 GE5Q3080     489
      WW(J)= WQ(I)                                                    GE5Q3090
  710 CONTINUE                                                        GE5Q3100
      WRITE (NTP3)  (WW(L), L=1,NMO)                                  GE5Q3110     497
  720 CONTINUE                                                        GE5Q3120
  770 CONTINUE                                                        GE5Q3130
      RETURN                                                          GE5Q3140
      END                                                             GE5Q3150
```

```
      SUBROUTINE AUGW(NMO,NBOX,NBE,NMTB,N4,N6,NRF,JRF,J ,COEFB,ASUM)      AUGW0010
      COMMON  NCNSMI,N6,NDELT,NDATA,NOPAN,IO,IW,JSPECS,FMACH,NCARAY(20),AUGW0020
     1         NSARAY(20),NBARAY(20),ALAP,B2,FL,BETA,PI,KR,KROBR,GMA(50),AUGW0030
     2         X(400),Y(400),Z(400),Z1(400),P1(400),Z1(400),Z2(400),      AUGW0040
     3         P2(400),ZZ(400),EV(400),PV(400),ZV(400),SDELX(400),        AUGW0050
     4         DELY(400)                                                  AUGW0060
      COMMON/NTPS/ NTP1,NTP2,NTP3,NTP4,NTP5,NTP6,NTP7,NTP8,NTP9,NTP10     AUGW0070
      COMMON  /BODY/ RO( 80),ROP( 80),NBEA(20),BGMA(20),MRK(20,2)         AUGW0080
      DIMENSION  NB(80),NARQ(80),LARQ(120,2),YIN(20),ZIN(20),COEFP(20),   AUGW0090
     1               COEFR(20),ARQ(120),BP( 80),H(400),DH1(400),DH2(400)  AUGW0100
      COMMO   /MODE/ NB,NARQ,LARQ,ARQ,H,DH1,DH2                           AUGW0110
      COMPLEX    AZY( 80),DCP( 80),WJ( 80),WJP( 80),ASUM(400),SUM         AUGW0120
      COMPLEX    TRM1, TRM2, TRM3                                         AUGW0130
      REAL       KR,KROBR,KKK,KK1                                         AUGW0140
    5 FORMAT   (12I5)                                                     AUGW0150
   15 FORMAT   (6F10.0)                                                   AUGW0160
   20 FORMAT   (1H0,5X,27H BODY  MODE   N  M         ARQ/)                AUGW0170
   25 FORMAT   (1H0,4X,2I6,2I3,F12.4)                                     AUGW0180
   30 FORMAT   (6(4I2,2X))                                                AUGW0190
   35 FORMAT   (3(2I2,6X,F10.0))                                          AUGW0200
   37 FORMAT   (1H0,25X,3HTHE,I4,31H B-MATRIX ELEMENTS FOR MODE NO.,I4)   AUGW0210
   40 FORMAT   (1H0,25X,3HTHE,I4,32H WJ MATRIX ELEMENTS FOR MODE NO.,I4)  AUGW0220
   45 FORMAT   (1H0,6F17.8)                                               AUGW0230
   50 FORMAT   (1H0,25X,3HTHE,I4,31H WJ-PRIME ELEMENTS FOR MODE NO.,I4)   AUGW0240
   64 FORMAT   (1H0, 8HCOL. NO.,I4,18H  OF DEL-CP MATRIX//)               AUGW0250
   66 FORMAT   (1H0,13X,7HROW NO.,I4,7H OF THE,I4,17H API-APY ELEMENTS/)  AUGW0260
   68 FORMAT   (1H0,10X,10HCOLUMN NO.,I4,19H OF THE AUGW MATRIX//)        AUGW0270
      EPS   = 0.001                                                       AUGW0275
      S     = B2                                                          AUGW0280
      AR    = FL/2.0                                                      AUGW0290
      NP    = NOPAN                                                       AUGW0300
      M     = 5                                                           AUGW0310
      N     = 5                                                           AUGW0320
      NTP8 = NTP2                                                         AUGW0330
      REWIND  NTP8                                                        AUGW0340
      MTAPE=  11                                                          AUGW0350
      REWIND  MTAPE                                                       AUGW0360
      NBEL = NBEA(NB)                                                     AUGW0370
      IF (N6.EQ.1)  READ (MTAPE)  NUMR                                    AUGW0380
      IF (N6.EQ.2)  READ (5, 5 )  NUMR                                    AUGW0390
      IF (N6.NE.0.AND.NUMR.NE.NBEL)  STOP                                 AUGW0400
      IF (J.GT.1)  GO TO 82                                               AUGW0410
      IF (NRF.GT.1.AND.JRF.GT.1)  GO TO 70                                AUGW0420
      IF (N6.NE.0)  GO TO  81                                             AUGW0430
      NMT) = NMO*NB                                                       AUGW0440
      DO  56  K=1,NMT ,6                                                  AUGW0450
      KP1   = K+1                                                         AUGW0460
      KP2   = K+2                                                         AUGW0470
      KP3   = K+3                                                         AUGW0480
      KP4   = K+4                                                         AUGW0490
      KP5   = K+5                                                         AUGW0500
```

```
      READ  (5,30) NR1,NQ1,NARQ(K  ),N8(K  ),NR2,NQ2,NARQ(KP1),N8(KP1),
     1             NR3,NQ3,NARQ(KP2),N8(KP2),NR4,NQ4,NARQ(KP3),N8(KP3),
     2             NR5,NQ5,NARQ(KP4),N8(KP4),NR6,NQ6,NARQ(KP5),N8(KP5)
   54 CONTINUE
      DO  56  K=1,NMTS,3
      KP1  = K+1
      KP2  = K+2
      READ  (5,35) LARQ(K,   1),LARQ(K,   2),ARQ(K   ),
     1             LARQ(KP1,1),LARQ(KP1,2),ARQ(KP1),
     2             LARQ(KP2,1),LARQ(KP2,2),ARQ(KP2)
   56 CONTINUE
      WRITE (6,20)
      KK    = 0
      K     = 0
      DO  60  JO=1,NMO
      DO  58  L=1,NB
      KK    = KK+1
      NQ    = NARQ(KK)
      IF (NQ.EQ.0)  GO TO 58
      DO  57  I=1,NQ
      K     = K+1
      WRITE (6,25)  L,JO,LARQ(K,1),LARQ(K,2),ARQ(K)
   57 CONTINUE
   58 CONTINUE
   60 CONTINUE
      IF (NRF.GT.1.AND.JRF.EQ.1)  GO TO 67
      GO TO 80
   67 CONTINUE
      IF (NMO.LT.2)  GO TO 609
      DO  69  JMP=2,NMO
      READ  (NTP8)
   69 CONTINUE
  609 CONTINUE
      READ  (NTP8)
      WRITE (NTP8)  NQ,NARQ,LARQ,ARQ
      REWIND NTP8
      READ  (NTP8)
      GO TO  90
   70 CONTINUE
      IF (NMO.LT.2)  GO TO 79
      DO  78  JMP=2,NMO
      READ  (NTP8)
   78 CONTINUE
   79 CONTINUE
      READ  (NTP8)
      READ  (NTP8)  NQ,NARQ,LARQ,ARQ
      REWIND NTP8
      READ  (NTP8)
   90 CONTINUE
      NQ    = 0
      NK    = 0
      NKA   = 0
      NKB   = 0
```

```
      GO TO  82
   81 CONTINUE
      GO TO  ( 84, 86),  NO
   84 CONTINUE
      READ  (MTAPE)  (HB(II),   II=1,NBEL)
      READ  (MTAPE)  (H(II),    II=1,NBEL)
      READ  (MTAPE)  (DH1(II),  II=1,NBEL)
      READ  (MTAPE)  (DH2(II),  II=1,NBEL)
      GO TO  182
   86 CONTINUE
      READ  (5, 15)  (HB(II),   II=1,NBEL)
      READ  (5, 15)  (H(II),    II=1,NBEL)
      READ  (5, 15)  (DH1(II),  II=1,NBEL)
      READ  (5, 15)  (DH2(II),  II=1,NBEL)
      GO TO  182
   82 CONTINUE
      IC    = NBCK
      I1    = IC+1
      I2    = IC+NBEA(1)
      K     = 0
      DO 180  L=1,NB
      IF (L.EQ.1)  GO TO 87
      I1    = I2+1
      I2    = IC+NBEA(L)
   87 CONTINUE
      NK    = NK+1
      NP1   = N+1
      NM1   = N-1
      MP1   = M+1
      NQ    = NARQ(NK)
      NKA   = NKB+1
      NKB   = NKB+NQ
      DO 160  I=I1,I2
      K     = K+1
      XQ    = X(I)
      XOS   = XQ/S
      YI    = Y(I)
      ZL    = ZZ(I)
      YQ    = Y(I)-YI*FLOAT(NB(NK))
      ZQ    =ZZ(I)-ZL*FLOAT(NB(NK))
      TI    = SQRT(YQ*YQ + ZQ*ZQ)
      TOS   = TI/S
      HRDI = 0.0
      DH1X = 0.0
      DH2X = 0.0
      TOSM = 1.0
      DO 140  JK=1,MP1
      XOSN = 1.0
      XOSN1= 1.0
      XOSN2= 1.0
      DO 120  IX=1,NP1
      AFONM= 0.0
      IF (NQ.EQ.0)  GO TO 100
```


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```
      DO 90 NKK=NKA,NKB
      LN   = LARJ(NKK,1)+1
      LM   = LARJ(NKK,2)+1
      IF (LN.EQ.IK.AND.LM.EQ.JK)   ARJNM=ARJ(NKK)
   90 CONTINUE
  100 CONTINUE
      HBJ1 = HBQ1   + COEFB(L)*ARJNM*XOSN *TOSM
      OM1X = OM1X   + COEFA(L)*ARJNM*XOSN1*TOSM*FLOAT(IK-1)
      OM2X = OM2X + COEFA(L)*ARJNM*XOSN2*TOSM*FLOAT(IK-2)*FLOAT(IK-1)/S
      XOSN = XOSN*XOS
      IF (IK.EQ.1)     GO TO 120
      XOSN1= XOSN1*XOS
      IF (IK.LE.2)     GO TO 120
      XOSN2= XOSN2*XOS
  120 CONTINUE
      TOSM = TOSM*TOS
  140 CONTINUE
      DELAT = SDELX(I)*DELY(I)
      IF (ABS(Y(I)).GT.0.0001)   DELAT=2.0*DELAT
      RB(K) = DELAT * HBJ1 / (S*S)
      WRE   = OM1X
      WIM   = (HBJ1*KR*S)/BR
      WJ(K) = CMPLX(WRE,WIM)
      WREP = OM2X
      WIMP = KR*  OM1X/BR
      WJP(K) = CMPLX(WREP,WIMP)
      TRM1 = 2.0*ROP(K)*WJ(K)
      TRM2 = RO(K) * WJP(K)
      TRM31= KR*RO(K)/R4
      TRM3 = (CMPLX(0.0,TRM31))*WJ(K)
      DCP(K) = PI*(TRM1+TRM2+TRM3)
  160 CONTINUE
  189 CONTINUE
  192 CONTINUE
      WRITE (6,37)  NBE,J
      WRITE (6,45)  (RB(KK),  KK=1,NBE)
      WRITE (NTP8)  (RB(KK),  KK=1,NBE)
      IF (N6.EQ.0)  GO TO 138
      DO 137  IW=1,NRF
      WRE        = OH1(IW)
      WIM        = (H1(IW)*KR*S)/BR
      WJ(I-)     = CMPLX(WRE,WIM)
      WREP       = OH2(IW)
      WIMP       = OH1(IW)*KR/BR
      WJP(IW)    = CMPLX(WREP,WIMP)
      TRM1       = 2.0*ROP(IW)*WJ(IW)
      TRM2       = RO(IW)*WJP(IW)
      TRM31      = KR*RO(IW)/BR
      TRM3       = (CMPLX(0.0,TRM31))*WJ(IW)
      DCP(IW) = PI*(TRM1+TRM2+TRM3)
  137 CONTINUE
  138 CONTINUE
      WRITE (6,40)  NBE,J
      WRITE (6,45)  (WJ(KK),  KK=1,NBE)
      WRITE (6,50)  NBE,J
      WRITE (6,45)  (WJP(KK), KK=1,NBE)
      WRITE (6,64)  J
      WRITE (6,45)  (DCP(K), K=1,NBE)
      WRITE (NTP7 ) (DCP(K), K=1,NBE)
  200 CONTINUE
      NPAN = 1
      DO 600  I=1,NBOX
      SUM      = (0.0,0.0)
      ASUM(I) = (0.0,0.0)
      NBODY= 1
      NFRN = NBEA(NBODY)
      KF    = NBOX
      DO 400  K=1,NBE
      MARK1= MRK(NBODY,1)
      MARK2= MRK(NBODY,2)
      AZY(K) = (0.0,0.0)
      IF (I.GE.MARK1.AND.I.LE.MARK2)  GO TO 375
      KF     = KF+1
      XO     = X(I) - EV(KF)
      EE     = RO(K)
      E2     = EE*EE
      GAMS = GMA(NPAN)
      KKER = SDELX(KF)*KO(K)/(2.0*PI)
      XKR   = 0.0
      XKI   = 0.0
      IGO   = 1
      FLAGN= 1.0
      YO     = Y(I)  - PV(KF)
      ZO     = ZZ(I) - ZV(KF)
      GAMSIG = BGMA(NBODY)
  365 CONTINUE
      CALL          TKER  (XO,YO,ZO,KR,MN,GAMS,GAMSIG,FMACH,E2,KKR,KKI)
      XKR   = XKR + KKR*FLAGN
      XKI   = XKI + KKI*FLAGN
      GO TO  (366,367,368,369),  IGO
  366 CONTINUE
      IF (NDELT.EQ.0.OR.(ABS(PV(KF))).LE.EPS)  GO TO 367
      YO     = Y(I)  + PV(KF)
      GAMSIG = -BGMA(NBODY)
      IGO   = 2
      FLAGN= FLOAT(NDELT)
      GO TO  365
  367 CONTINUE
      IF (JSPECS.EQ.0.OR.(ABS(ZV(KF))).LE.EPS)  GO TO 369
      YO     = Y(I)  - PV(KF)
      ZO     = ZZ(I) + ZV(KF)
      GAMSIG = -BGMA(NBODY)
      IGO   = 3
      FLAGN= FLOAT(JSPECS)
      GO TO  365
  368 CONTINUE
      IF (NDELT.EQ.0.OR.(ABS(PV(KF))).LE.EPS)  GO TO 369
      YO     = Y(I)  + PV(KF)
      GAMSIG =  BGMA(NBODY)
      IGO   = 4
      FLAGN= FLOAT(NDELT)*FLOAT(JSPECS)
      GO TO  365
  369 CONTINUE
      XKR   = XKR*KKER
      XKI   = XKI*KKER
      AZY(K) = CMPLX(XKR , XKI)
  375 CONTINUE
      SUM   = SUM + AZY(K)*DCP(K)
      IF (K.NE.NFRN)  GO TO 400
      NBODY= NBODY+1
      NFRN = NBEA(NBODY)
  400 CONTINUE
      ASUM(I) = SUM
      IF (N6.EQ.0)  GO TO 405
      WRITE (6,66)  I,NBE
      WRITE (6,45)  (AZY(K), K=1,NBE)
  405 CONTINUE
      IF (I.EQ.NRARAY(NPAN))  NPAN=NPAN+1
  600 CONTINUE
      WRITE (6,68)   J
      WRITE (6,45)  (ASUM(I),  I=1,NBOX)
      RETURN
      END
```

```
      SUBROUTINE TKER  (XO,YO,ZO,KR,BR,GAMS,GAMSIG,FMACH,E2,KKR,KKI)
      REAL    M, KR, KKR, KKI, IOOR, IOOI, JOOR, JOOI, I1OR, I1OI, I2OR3,
     1        I2OI3, IOUR, IOUI, JOUR, JOUI, I1UR, I1UI, I2UR3, I2UI3,
     2        K1, MU1, MU, K2
      REAL    K1O,K2O,K1RT1,K1IT1,K2RT2P,K2IT2P,K1OT1,K2OT2P
   10 FORMAT  (1H0,6E15.6/)
   11 CONTINUE
      L     = 0
      PI    = 3.1415926
      PI2    = PI*PI
      EPS   = 0.00001
      M     = FMACH
      R1= SQRT (YO*YO+ZO*ZO)
      R1S = R1
      RTWO    = R1*R1
      RFOUR   = RTWO*RTWO
      K1O     = 0.0
      K2O     = 0.0
      K1RT1   = 0.0
      K1IT1   = 0.0
      K2RT2P  = 0.0
      K2IT2P  = 0.0
      K1OT1   = 0.0
      K2OT2P  = 0.0
      IF  ( R1 )               200,100,200
  100 IF  ( XO )               110,120,120
  110 KKR=0.
      KKI=0.
      GO TO  987
  120 C1= KR*XO/BR
      T1= COS(GAMS-GAMSIG)
      K1O     = 2.0
      K1RT1   = 2.0*T1*COS(C1)
      K1IT1   =-2.0*T1*SIN(C1)
      K1OT1   = 2.0*T1
      GO TO  905
  200 C1=COS(GAMS)
      C2=SIN(GAMS)
      C3=COS(GAMSIG)
      C4=SIN(GAMSIG)
      T2P=(ZO*ZO*C1*C3+YO*YO*C2*C4-ZO*YO*(C2*C3+C1*C4))
      T2 = T2P/R2
      IF  ( ABS(T2)-EPS )                     210,220,220
  210 ICMUZ=1
      T1= COS(GAMS-GAMSIG)
      T2=0.
      GO TO 900
  220 T1= COS(GAMS-GAMSIG)
      IF  ( ABS(T1)-EPS )                     230,240,240
  230 ICMUZ=2
      T1=0.
      GO TO 900
  240 ICMUZ=3
  900 BETA2 = (1.-M*M)
      BIGR = SQRT (XO*XO+BETA2*R1*R1)
```



```
      K1= KR*R1/BR
      MU1= (M*BIGR-XO)/ (BETA2*R1)
      MU=ABS(MU1)
      K2=K1*K1
      IF  ( MU1 )              310,320,330
  310 ICMUZ=ICMUZ+3
      GO TO 330
  320 ICMUZ=ICMUZ+6
C     (N*C)**2  FOR  N=1,11  AND C=.372 =
C
C       .138384        .553536       1.245456       2.214144
C      3.4596         4.981824       6.780816       8.856576
C     11.209104      13.8384        16.744464
C
C     (N*C)  FOR  N=1,12  AND  14,16,18,20,22   =
C
C        .744          1.116          1.488          1.86        2.232
C       2.604          2.976          3.348          3.72         .092
C       4.464          5.208          5.952          6.696       7.44
C       8.184
C
C     A(N)  FORN=1,11  =
C
C       .24186198      -2.7918027      24.991079     -111.59196
C     271.43549      -305.75288       -41.18363       545.98537
C    -644.78155       328.72755       -64.279511
  330 E= EXP (-.372*MU)

       C1 = .138384*K2
       C2 = .553536*K2
       C3 = 1.245456*K2
       C4  = 2.214144 *K2
       C5  = 3.4596   *K2
       C6  = 4.981824 *K2
       C7  = 6.780816 *K2
       C8  = 8.856576 *K2
       C9  = 11.209104*K2
       C10 = 13.8384  *K2
       C11 = 16.744464*K2

       R1  = .24186198 / C1
       R2  =-2.7918027 / C2
       R3  = 24.991079 / C3
       R4  =-111.59196 / C4
       R5  = 271.43549 / C5
       R6  =-305.75288 / C6
       R7  =-41.18363  / C7
       R8  = 545.98537 / C8
       R9  =-644.78155 / C9
       R10 = 328.72755 / C10
       R11 =-64.279511 / C11

       IF  ( ICMUZ .GT. 6 )                      GO TO 340
       IOOR = .372*(R1 +2.*R2 + 3.*R3 + 4.*R4 + 5.*R5 + 6.*R6 + 7.*R7 +
     1          8.*R8 + 9.*R9 + 10.*R10 + 11.*R11)
       IOOI = -K1*(R1+R2+R3+R4+R5+R6+R7+R8+R9+R10+R11)
```

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TKER         - EFN   SOURCE STATEMENT  -  (FN(S)  -                    01/15/71

340 GO TO  (420,350,350,390,350,350,380,350,350),ICHUZ                    TKER1120
                                                                          TKER1130
350 Q1   = R1/ C1                                                         TKER114C
    Q2   = R2/ C2                                                         TKER1150
    Q3   = R3/ C3                                                         TKER1160
    Q4   = R4/ C4                                                         TKER1170
    Q5   = R5/ C5                                                         TKER1180
    Q6   = R6/ C6                                                         TKER1190
    Q7   = R7/ C7                                                         TKER1200
    Q8   = R8/ C8                                                         TKER1210
    Q9   = R9/ C9                                                         TKER1220
    Q10  = R10/C10                                                        TKER1230
    Q11  = R11/C11                                                        TKER1240
                                                                          TKER1250
    GO TO  (420,410,410,390,36C,360,38C,360,360),ICHUZ                    TKER1260
                                                                          TKER1270
360 JOOR =  Q1*(.138384-K2)+Q2*(.553536-K2)+Q3*(1.245456-K2)+Q4*          TKER1280
   1        (2.214144-K2)+Q5*(3.4596-K2)+Q6*(4.981824-K2)+Q7*(6.780816TKER1290
   2        -K2)+Q8*(8.856576-K2)+Q9*(11.209104-K2)+Q10*(13.8384-K2)+ TKER1300
   3        Q11*(16.744464-K2)                                            TKER1310
    I20R3= 2.*K1*I00I+K2*JOOR                                             TKER1320
                                                                          TKER1330
    GO TO  (420,41C,410,390,410,390,380,370,370),ICHUZ                    TKER1340
                                                                          TKER1350
370 JOOI = -K1*(.744*Q1+1.488*Q2+2.232*Q3+2.976*Q4+3.72*Q5+4.464*Q6+      TKER1360
   1             5.208*Q7+5.952*Q8+6.696*Q9+7.44*Q10+8.184*Q11)           TKER1370
    I20I3= -K1*I00R+K2*JOOI                                               TKER1380
                                                                          TKER1390
    IF  ( ICHUZ .EQ. 9 )                   GO TO 500                      TKER1400
380 I10I = -K1*I00R                                                       TKER1410
390 I10R = 1.+K1*I00I                                                     TKER1420
                                                                          TKER1430
400 GO TO (420,41C,410,420,410,410,500,500,500),ICHUZ                     TKER1440
                                                                          TKER1450
410 JOUR = E*(Q1*(.138384-K2+.372*MU*C1)+                                 TKER1460
   1         E*(Q2*(.553536-K2+.744*MU*C2)+                               TKER1470
   2         E*(Q3*(1.245456-K2+1.116*MU*C3)+                             TKER1480
   3         E*(Q4*(2.214144-K2+1.488*MU*C4)+                             TKER1490
   4         E*(Q5*(3.4596-K2+1.86*MU*C5)+                                TKER1500
   5         E*(Q6*(4.98182-K2+2.232*MU*C6)+                              TKER1510
   6         E*(Q7*(6.780816-K2+2.604*MU*C7)+                             TKER1520
   7         E*(Q8*(8.856576-K2+2.976*MU*C8)+                             TKER1530
   8         E*(Q9*(11.209104-K2+3.348*MU*C9)+                            TKER1540
   9         E*(Q10*(13.8384-K2+3.72*MU*C10)+                             TKER1550
   A         E*(Q11*(16.744464-K2+4.092*MU*C11)))))))))))                 TKER1560
                                                                          TKER1570
      JOUI = -K1*(E*(Q1*(.744*MU*C1) + E*(Q2*(1.488*MU*C2) +              TKER1580
   1              E*(Q3*(2.232*MU*C3)+ E*(Q4*(2.976*MU*C4) +              TKER1590
   2              E*(Q5*(3.72*MU*C5) + E*(Q6*(4.464*MU*C6) +              TKER1600
   3              E*(Q7*(5.208*MU*C7) + E*(Q8*(5.952*MU*C8) +             TKER1610
   4              E*(Q9*(6.696*MU*C9) + E*(Q10*(7.44*MU*C10) +            TKER1620
   5              E*(Q11*(8.184*MU*C11)))))))))))))                       TKER1630
                                                                          TKER1640
420 TOUR = .372*E*(R1+E*(2.*R2+E*(3.*R3+E*(4.*R4+E*(5.*R5+E*(6.*R6+       TKER1650
   1             E*(7.*R7+E*(8.*R8+E*(9.*R9+E*(10.*R10+E*11.*R11)))))))))) TKER1660
```

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TKER         - EFN   SOURCE STATEMENT  -  (FN(S)  -                    01/15/71

   2                 ))))                                                 TKER1680
                                                                          TKER1690
    IOUI = -K1*(E*(R1+E*(R2+E*(R3+E*(R4+E*(R5+E*(R6+E*(R7+E*(R8+E*(R9 TKER1700
   1            +E*(R10+E*R11))))))))))))                                 TKER1710
    R1   = R15                                                            TKER1720
    C6= K1*MU                                                             TKER1730
    C1= SIN(C6)                                                           TKER1740   56
    C2= COS(C6)                                                           TKER1750   57
    C3= SQRT(1.+MU*MU)                                                    TKER1760   58
    C4= MU/C3                                                             TKER1770
    C5= C4/(1.+MU*MU)                                                     TKER1780
    GO TO  (430,440,430,430,44C,430,500,500,500),ICHUZ                    TKER1790
430 I1UR = C2*(1.-C4*K1*IOUI)-C1*K1*IOUR                                  TKER1800
    I1UI =-C2*K1*IOUR-C1*(1.-C4*K1*IOUI)                                  TKER1810
    GO TO  (500,440,440,460,440,440,500,500,500),ICHUZ                    TKER1820
440 I2UR3 = C2*(2.*(1.-C4)-C5*K1*IOUI+K2*JOUR)+C1*(C6*(1.-C4)-K1*IOUR TKER1830
   1          +K2*JOUI)                                                   TKER1840
    I2UI3 = C2*(C6*(1.-C4)-K1*IOUR+K2*JOUI)-C1*(2.*(1.-C4)-C5*K1*IOUI TKER1850
   1          +K2*JOUR)                                                   TKER1860
    GO TO  (500,50C,500,460,450,450,500,500,500),ICHUZ                    TKER1870
450 I2UR3 = 2.0 * I20R3 - I2UR3                                           TKER1880
    IF  ( ICHUZ-6 )                    500,460,500                        TKER1890
460 CAR = 2.*I10R-I1UR                                                    TKER1900
    I1UR= CAR                                                             TKER1910
500 DK1R=0.                                                               TKER1920
    DK1I=0.                                                               TKER1930
    DK2R=0.                                                               TKER1940
    DK2I=0.                                                               TKER1950
    C3=K1*MU1                                                             TKER196C
    C1=COS(C3)                                                            TKER1970   68
    C2=SIN(C3)                                                            TKER1980   69
    C3= H*R1/BIGR                                                         TKER1990
    C4=SQRT(1.+MU1*MU1)                                                   TKER2000   70
    C5=KR*X0/BR                                                           TKER2010
    C6=COS(C5)                                                            TKER2020   71
    C7=SIN(C5)                                                            TKER2030   72
    GO TO (530,540,53C,530,540,530,510,570,510),ICHUZ                     TKER2040
510 I1UR=I10R                                                             TKER2050
    I1UI=I10I                                                             TKER2060
    IF  ( ICHUZ-7 )                    520,530,520                        TKER2070
520 I2UR3= I20R3                                                          TKER2080
    I2UI3= I20I3                                                          TKER2090
    IF  ( ICHUZ-8 )                    530,540,530                        TKER2100
530 CK1R = I1UR + C3*C1/C4                                                TKER2110
    CK1I = I1UI - C3*C2/C4                                                TKER2120
    K10  = 1.0 + X0/BIGR                                                  TKER2130
    DK1R = CK1R*C6 + CK1I*C7                                              TKER2140
    DK1I = CK1I*C6 - CK1R*C7                                              TKER2150
    GO TO  (900,540,540,900,540,540,900,540,540),ICHUZ                    TKER2160
540 C8=  (BETA2*(R1/BIGR)**2 + (2.+MU1*C3)/(C4*C4))*(-C3/C4)              TKER2170
    C9= ( K1*C3)*( C3/C4)                                                 TKER2180
    CK2R = -I2UR3 + C8*C1 - C9*C2                                         TKER2190
    CK2I = -I2UI3 - C9*C1 - C8*C2                                         TKER2200
    K20  = -2.0 - X0*(2.0+BETA2*(R1/BIGR)**2)/BIGR                        TKER2210
    DK2R = CK2R*C6 + CK2I*C7                                              TKER2220
    DK2I = CK2I*C6 - CK2R*C7                                              TKER2230
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      GO TO 110                                                      PRT20510
  130 CONTINUE                                                       PRT20520
      CV    = SDELXI(IR)                                             PRT20530
      JSPEC  = JSPECS                                                PRT20540
  140 CONTINUE                                                       PRT20550
  150 AY   =  Y(IQ) - PV(IR)                                         PRT20560
      AY1  =  Y(IQ) - P1(IR)                                         PRT20570
      AY2  =  Y(IQ) - P2(IR)                                         PRT20580
  160 AX   =  X(IQ) - EV(IR)                                         PRT20590
      AX1  =  X(IQ) - Z1(IR)                                         PRT20600
      AX2  =  X(IQ) - Z2(IR)                                         PRT20610
      AZ   = ZZ(IQ) - ZV(IR)                                         PRT20620
      AZ1  = ZZ(IQ) -ZZ1(IR)                                         PRT20630
      AZ2  = ZZ(IQ) -ZZ2(IR)                                         PRT20640
      EE =  DELY(IR)/2.                                              PRT20650
      WEIRD = ZZ(IR) -Z1(IR)                                         PRT20660
      AWEIRD = ABS(WEIRD)                                            PRT20670
      IF (AWEIRD.LT.SMALL) GO TO 200                                 PRT20680
      TL =    (((Z2(IR)-Z1(IR))/   DELY(IR)      )*CGS)/BETA         PRT20690

      SQTL = SQRT(1. + TL**2)                                        PRT20720     76
      SL   = TL /SQTL                                                PRT20730
      CL   = 1. /SQTL                                                PRT20740
      GO TO  210                                                     PRT20750

  200 TL = 0.                                                        PRT20780
      SQTL = 1.                                                      PRT20790
      CL = 1.                                                        PRT20800
      SL = 0.                                                        PRT20810
      EE = (DELY(IR))/2.                                             PRT20820
  210 CONTINUE                                                       PRT20830
      SSDELR = 0.                                                    PRT20840
      SSDELI = 0.                                                    PRT20850
      SDELR = 0.0                                                    PRT20860
      SDELI = 0.0                                                    PRT20870
  220  DELR = 0.0                                                    PRT20880
      DELI = 0.0                                                     PRT20890
      SAVE1  =  0.                                                   PRT20900
      SAVE2  =  0.                                                   PRT20910
      NOBLE = 0                                                      PRT20920
  230 CONTINUE                                                       PRT20930
      LMS = 0                                                        PRT20940
      IF (KRDBR.LE.SMALL)  GO TO 240                                 PRT20950
      CALL        INCROT(AX,AY,AZ,AX1,AY1,AZ1,AX2,AY2,AZ2,GAMS,GAMSIG,LMS,PRT20960
     1IR, NFF ,IQ,NBFS,NCPNB,NOBLE,NBV,DELR,DELI,FL,BETA,SDELX,DELY,KR)   PRT20970     93
      SDELR  = SDELR + DELR*(FLOAT(MULT))                            PRT20980
      SDELI  = SDELI + DELI*(FLOAT(MULT))                            PRT20990
  240 CONTINUE                                                       PRT21000
      XO = AX                                                        PRT21010
      YO = AY                                                        PRT21020
      ZO = AZ                                                        PRT21030
      CALL        SNPDF(SL,CL,TL,SGS,CGS,SGR,CGR,XO,YO,ZO,EE,DIJ,BETA,CV)PRT21040     96
      SAVE1  = SAVE1 + DIJ *(FLOAT(MULT))                            PRT21050
      IF (NDRAG.EQ.0)  GO TO  250                                    PRT21060
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      XPRIME = EV(IQ) - EV(IR)                                       PRT21070
      CALL        SNPDF(SL,CL,TL,SGS,CGS,SGR,CGR,XO,YO,ZO,EE,DIJ,BETA,CV)PRT21080     180
      DR    = DR     + DIJ *(FLOAT(MULT))                            PRT21090
  250 CONTINUE                                                       PRT21100
      IF (JSPEC.EQ.0)  GO TO  270                                    PRT21110
  260 GAMSIG =-GAMSIG                                                PRT21120
      SGS     =-SGS                                                  PRT21130
      AZ   = ZZ(IQ) + ZV(IR)                                         PRT21140
      AZ1 = ZZ(IQ) +ZZ1(IR)                                          PRT21150
      AZ2 = ZZ(IQ) +ZZ2(IR)                                          PRT21160
      NOBLE = JSPEC                                                  PRT21170
      JSPEC = 0                                                      PRT21180
      MULT = JSPECS                                                  PRT21190
      GO TO 230                                                      PRT21200
  270 CONTINUE                                                       PRT21210
      NOBLE = 0                                                      PRT21220
      IF (NDELT.EQ.0)  GO TO 350                                     PRT21230
      IF (NYAW.EQ.0)  GO TO 280                                      PART1240
      IF (IQ.GT.NBV)  GO TO 280                                      PART1245
      IF (NDBLT.EQ.1)  GO TO 350                                     PRT21250
      SSDELR = -SDELR                                                PRT21260
      SSDELI = -SDELI                                                PRT21270
      SAVE2  = -SAVE1                                                PRT21280
      DL = -DR                                                       PRT21290
      GO TO  350                                                     PRT21300
  280 CONTINUE                                                       PRT21310
      JSPEC  = JSPECS                                                PRT21320
  290 SL    = -SL                                                    PRT21330
      TL    = -TL                                                    PRT21340
      AZ    = ZZ(IQ) - ZV(IR)                                        PRT21350
      AZ1   = ZZ(IQ) -ZZ2(IR)                                        PRT21360
      AZ2   = ZZ(IQ) -ZZ1(IR)                                        PRT21370
      AY    =  Y(IQ) + PV(IR)                                        PRT21380
      AY1   =  Y(IQ) + P2(IR)                                        PRT21390
      AY2   =  Y(IQ) + P1(IR)                                        PRT21400
      SAX2 = AX2                                                     PRT21410
      AX2  = AX1                                                     PRT21420
      AX1  =SAX2                                                     PRT21430
  300 GAMSIG = -GMA(IG)                                              PRT21440
      SGS     = SIN(GAMSIG)                                          PRT21450     190
      MULT = 1                                                       PRT21460
  310 CONTINUE                                                       PRT21470
      LMS = 1                                                        PRT21480
      IF (KRDBR.LE.SMALL) GO TO 320                                  PRT21490
      CALL        INCROT(AX,AY,AZ,AX1,AY1,AZ1,AX2,AY2,AZ2,GAMS,GAMSIG,LMS,PRT21500
     1IR, NFF ,IQ,NBFS,NCPNB,NOBLE,NBV,DELR,DELI,FL,BETA,SDELX,DELY,KR)   PRT21510     196
      SSDELR =SSDELR + DELR*(FLOAT(MULT))                            PRT21520
      SSDELI =SSDELI + DELI*(FLOAT(MULT))                            PRT21530
  320 CONTINUE                                                       PRT21540
      XO = AX                                                        PRT21550
      YO = AY                                                        PRT21560
      ZO = AZ                                                        PRT21570
      CALL        SNPDF(SL,CL,TL,SGS,CGS,SGR,CGR,XO,YO,ZO,EE,DIJ,BETA,CV)PRT21580     199
      SAVE2  = SAVE2 + DIJ *(FLOAT(MULT))                            PRT21590
      IF (NDRAG.EQ.0)  GO TO  330                                    PRT21600
      XPRIME = EV(IQ) - EV(IR)                                       PRT21610
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TKBR        -  EFN   SOURCE STATEMENT  -  IFN(S)  -                    01/15/71

900 CONTINUE                                                            TKER2240
    K1RT1   = T1 * DK1R                                                 TKER2250
    K1IT1   = T1 * DK1I                                                 TKER2260
    K2RT2P  = T2P* DK2R                                                 TKER2270
    K2IT2P  = T2P* DK2I                                                 TKER2280
    K1OT1   = K10* T1                                                   TKER2290
    K2OT2P  = K20* T2P                                                  TKER2300
905 CONTINUE                                                            TKER2310
    K1RT1   = K1RT1 /RTWO                                               TKER2320
    K1IT1   = K1IT1 /RTWO                                               TKER2330
    K1OT1   = K1OT1 /RTWO                                               TKER2340
    K2RT2P  = K2RT2P/RFOUR                                              TKER2350
    K2IT2P  = K2IT2P/RFOUR                                              TKER2360
    K2OT2P  = K2OT2P/RFOUR                                              TKER2370
    KKR   = K1RT1+K2RT2P - (K1OT1+K2OT2P)*FLOAT(L)                      TKER2380
    KKI   = K1IT1 + K2IT2P                                              TKER2390
907 CONTINUE                                                            TKER2400
    RETURN                                                              TKER2410
    END                                                                 TKER2420
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PART2       -  EFN   SOURCE STATEMENT  -  IFN(S)  -                    01/15/71

      SUBROUTINE PART2(NTAM,NBV)                                        PRT20010
      REAL      KR,KRDBR                                                PRT20020
      COMMON    NCNSM1,NB,NDEL1,NDATA,NDPAN,IQ,IR,JSPECS,FRACH,NCARAY(20),PRT20030
     1          NSARAY(20),NBARAY(20),ACAP,B2,FL,BETA,PI,KR,KRDBR,GMA(50),PRT20040
     2          X(400),Y(400),Z(400),Z1(400),P1(400),ZZ1(400),Z2(400),    PRT20050
     3          P2(400),ZZZ(400),EV(400),PV(400),ZV(400),SDELX(400),      PRT20060
     4          DELY(400)                                               PRT20070
      REAL   K10,K20,K1RT1,K1IT1,K2RT2P,K2IT2P,K1OT1,K2OT2P             PRT20074
      COMMON  /DLN/  K10,K20,K1RT1,K1IT1,K2RT2P,K2IT2P,K1OT1,K2OT2P,E2  PRT20076
      DIMENSION  ANW(400), ANWI(400)                                    PRT20080
      COMMON  /NTPS/  NTP1,NTP2,NTP3,NTP4,NTP5,NTP6,NTP7,NTP8,NTP9,NTP10PRT20085
      DIMENSION  DPRIME(400)                                            PRT20090
    5 FORMAT  (1H0,15I5)                                                PRT20095
   10 FORMAT (1H0,1'MANN PART OF ROW,I5,2X, 4HWITH,I5,2X,27HELEMENTS IS PRT20100
     1NOW PRINTED OUT)                                                  PRT20110
   30 FORMAT (1H0,6E20.8)                                               PRT20120
   40 FORMAT (1H0,22HMANN(R) VALUE FOR IR =,I4,2X,2HIS,E20.8)           PRT20130
   60 FORMAT  (1H0,25X,2I3,3F10.6,5X,I4//)                              PRT20140
   70 FORMAT (1H0,3X,9(F10.4,5X)/)                                      PRT20150
      FDELT = NDELT                                                     PRT20160
      SMALL  = 0.0001                                                   PRT20170
      NFF = 0                                                           PRT20180
      NDRAG= 0                                                          PRT20185
      DO 390  IQ = 1,NCNSM1                                             PRT20190
      ANWINT = 0.                                                       PRT20200
      NCASE = 0                                                         PRT20210
      IM = 0                                                            PRT20220
   90 IM = IM + 1                                                       PRT20230
      GAMS   = GMA(IM)                                                  PRT20240
      SGA    = SIN(GAMS)                                                PRT20250    11
      CGA    = COS(GAMS)                                                PRT20260    12
      ACGA   = ABS(CGA)                                                 PRT20270
      NBXR=NBARAY(IM)                                                   PRT20280
      IF(IQ.LE.NBXR) GO TO 100                                          PRT20290
      GO TO 90                                                          PRT20300
  100 CONTINUE                                                          PRT20310
      IG = 0                                                            PRT20320
      IR = 1                                                            PRT20330
      NB = 0                                                            PRT20340
      IO = 1                                                            PRT20350
  110 IG = IG + 1                                                       PRT20360
      GAMSIG= GMA(IG)                                                   PRT20370
      SGS    = SIN(GAMSIG)                                              PRT20380    26
      CGS    = COS(GAMSIG)                                              PRT20390    27
      ACGS = ABS(CGS)                                                   PRT20400
      NPS = IG                                                          PRT20410
      NCM1   =   NCARAY(NPS) - 1                                        PRT20420
      NBXS = NBARAY(NPS)                                                PRT20430
      NCPNB   = NCM1 + NB                                               PRT20440
  120 CONTINUE                                                          PRT20450
      MULT = 1                                                          PRT20460
      DP = 0.                                                           PRT20470
      DL = 0.                                                           PRT20480
      IF (IR.LE.NBXS) GO TO 130                                         PRT20490
      NB = NBXS                                                         PRT20500
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      PART2        -  EFN   SOURCE STATEMENT  -  IFN(S)  -                      01/19/71

      CALL        SNPCS(M ,CL,TL,SGS,CGS,SGR,CGR,X0,Y0,Z0,EE,DIJ,BETA,CV)PRT21620    166
      DL       = DL       + DIJ *(FLOAT(MULT))                               PRT21630
  330 CONTINUE                                                              PRT21640
      IF (JSPEC.EQ.0)  GO TO  350                                           PRT21650
      NOBLE = JSPEC                                                         PRT21660
  340 GAMSIG =  GMA(IG)                                                     PRT21670
      SGS      = SIN(GAMSIG)                                                PRT21680    174
      AZ     = ZZ(IQ) + ZV(IR)                                              PRT21690
      AZ1    = ZZ(IQ) +ZZ2(IR)                                              PRT21700
      AZ2    = ZZ(IQ) +ZZ1(IR)                                              PRT21710
      JSPEC = 0                                                             PRT21720
      MULT = JSPECS                                                         PRT21730
      GO TO 310                                                             PRT21740
  350 CONTINUE                                                              PRT21750
      DELR    = SDELR + SSDELR*FDELT                                        PRT21760
      DELT    = SDELI + SSDELI*FDELT                                        PRT21770
      DIJ     = SAVE1 + SAVE2 *FDELT                                        PRT21780
      ANM(IA    = DIJ - DELR                                                PRT21790
      ANM(I(IA)=-DELI                                                       PRT21800
      DPRIME(IR) = DR + DL*FDELT                                            PRT21810
      IR = IR + 1                                                           PRT21820
      GAMSIG = GMA(IG)                                                      PRT21830
      GAMS   = GMA(IM)                                                      PRT21840
      SGS      = SIN(GAMSIG)                                                PRT21850    190
      SGR      = SIN(GAMS)                                                  PRT21860    191
      IF(IR.GT.NCNSM1) GO TO  360                                           PRT21870
      IQ = IQ + 1                                                           PRT21880
      IF (IQ.GT.NCM1) IQ = 1                                                PRT21890
      GO TO  120                                                            PRT21900
      CONTINUE                                                              PRT21910
      IF (   NT   .EQ. 0) GO TO 380                                         PRT21920
      WRITE (6,10) IQ,NCNSM1                                                PRT21930    203
      WRITE (6,90)  (ANM(I),ANMI(I),  I=1,NCNSM1)                           PRT21940    204
      WRITE (NTP1)  (ANM(I),ANMI(I),  I=1,NCNSM1)                           PRT21970    210
      RETURN                                                                PRT21990
      END                                                                   PRT22000
                                                                            PRT22010
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      INCRO        -  EFN   SOURCE STATEMENT  -  IFN(S)  -                      01/19/71

      SUBROUTINE INCRO(AX,AY,AZ,AX1,AY1,AZ1,AX2,AY2,AZ2,GAMS,GAMSIG,LMS,INCRO0010
     1IR, NFF ,IO,NBXS,NCPNB,NOBLE,NBV,DELR,DELI,FL,BETA,SDELX,DELY,KR) INCRO0020
C     COMBINED  KERNEL-INTEGRATION PROGRAM                                  INCRO0030
      REAL    K10,K20,K1RT1,K1IT1,K2RT2P,K2IT2P,K1OT1,K2OT2P                INCRO0040
      COMMON  /DLN/  K10,K20,K1RT1,K1IT1,K2RT2P,K2IT2P,K1OT1,K2OT2P,E2      INCRO0050
      DIMENSION SDELX(400),DELY(400)                                        INCRO0060
      DIMENSION KUSE1(30,2),KUSE2(30,2),KUSE3(30,2),KUSE4(30,2)             INCRO0070
      DIMENSION JSE1(30,2), USE2(30,2), USE3(30,2), USE4(30,2)              INCRO0080
      REAL  M, KKR, KKI, KR,KROBA                                           INCRO0090
   10 FORMAT (1H0,6E20.8)                                                   INCRO0100
      NFF   = 0                                                             INCRO0105
      M = SQRT(1.0 - BETA**2)                                               INCRO0110     3
      BR   = FL/2.                                                          INCRO0120
      EPS = 0.00001                                                         INCRO0130
      XDELX = SDELX(IR)                                                     INCRO0140
      XDELY =  DELY(IR)                                                     INCRO0150
      SFN = SIN(GAMSIG)                                                     INCRO0160     6
      CFN = COS(GAMSIG)                                                     INCRO0170     7
      ACFN   = ABS(CFN)                                                     INCRO0180
                                                                            INCRO0190
      EE = 0.5*XDELY                                                        INCRO0200
      E2    = EE**2                                                         INCRO0210
      KKR = 0.0                                                             INCRO0220
      KKI = 0.0                                                             INCRO0230
      DELR = 0.0                                                            INCRO0240
      DELI = 0.0                                                            INCRO0250
      T1S   = 0.0                                                           INCRO0260
      T2S   = 0.0                                                           INCRO0270
      AT1S = 0.0                                                            INCRO0280
      AT2S = 0.0                                                            INCRO0290
      T1    = 0.0                                                           INCRO0300
      T2   = 0.0                                                            INCRO0310
      COUNT =0.                                                             INCRO0320
      X0=AX                                                                 INCRO0330
      Y0=AY                                                                 INCRO0340
      Z0=AZ                                                                 INCRO0350
      IF (NFF.EQ.0) GO TO  80                                               INCRO0360
      CALL        KERNEL(X0,Y0,Z0,KR,BR,GAMS,GAMSIG,M,EPS,T1,T2)            INCRO0370    11
      DELR = KKR                                                            INCRO0380
      DELI = KKI                                                            INCRO0390
      GO TO 260                                                             INCRO0400
   80 CONTINUE                                                              INCRO0410
      CALL        KERNEL(X0,Y0,Z0,KR,BR,GAMS,GAMSIG,M,EPS,T1,T2)            INCRO0420    15
      AT1    = ABS(T1)                                                      INCRO0430
      AT2    = ABS(T2)                                                      INCRO0440
      IF (AT1.GT.AT1S)  AT1S=AT1                                            INCRO0450
      IF (AT2.GT.AT2S)  AT2S=AT2                                            INCRO0460
      IF (COUNT)130,90,150                                                  INCRO0470
   90 DKRC    = K1RT1 - K1OT1                                               INCRO0480
      DKIC    = K1IT1                                                       INCRO0490
      KKRC    = K2RT2P-K2OT2P                                               INCRO0500
      KKIC    = K2IT2P                                                      INCRO0510
      AT2 = ABS(T2)                                                         INCRO0520
      JO = 1                                                                INCRO0530
      IF (NOBLE.NE.0) JO = 2                                                INCRO0540
```

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      INCRO        - EFN   SOURCE STATEMENT  -  IFN(S)  -                01/15/71

      IF (IR.LE.NCPNB) GO TO  110
      IF (IR.GT.NBFS) GO TO 110
      IF (LMS.NE.0) GO TO  100
      DKRI  = USE1(IO,JO)
      DKII  = USE2(IO,JO)
      XKRI  = XUSE1(IO,JO)
      XKII  = XUSE2(IO,JO)
      XO    = AX2
      YO    = AY2
      ZO = AZ2
      CALL         KERNEL(XO,YO,ZO,XR,BR,GAMS,GAMSIG,M,EP.,T1,T2)           39
      AT1   = ABS(T1)
      AT2   = ABS(T2)
      IF (AT1.GT.AT1S)  AT1S=AT1
      IF (AT2.GT.AT2S)  AT2S=AT2
      DKRO  = K1RT1 - K1OT1
      DF IO  = K1IT1
      XKRO  = K2RT2P-K2OT2P
      XKIO  = K2IT2P
      GO TO  170
  100 XO = AX1
      YO = AY1
      ZO = AZ1
      CALL         KERNEL(XO,YO,ZO,XR,BR,GAMS,GAMSIG,M,EPS,T1,T2)           47
      AT1   = ABS(T1)
      AT2   = ABS(T2)
      IF (AT1.GT.AT1S)  AT1S=AT1
      IF (AT2.GT.AT2S)  AT2S=AT2
      DKRI  = K1RT1 - K1OT1
      DKII  = K1IT1
      XKRI  = K2RT2P-K2OT2P
      XKII  = K2IT2P
      DKRO = USE3(IO,JO)
      DKIO = USE4(IO,JO)
      XKRO  = XUSE3(IO,JO)
      XKIO  = XUSE4(IO,JO)
      GO TO  160
  110 CONTINUE
      COUNT =-1.
  120 XO = AX1
      YO = AY1
      ZO = AZ1
      GO TO 80
  130 DKRI  = K1RT1 - K1OT1
      DKII  = K1IT1
      XKRI  = K2RT2P-K2OT2P
      XKII  = K2IT2P
  140 COUNT = 1.
      XO=AX2
      YO=AY2
      ZO=AZ2
      GO TO 80
  190 DKRO  = K1RT1 - K1OT1
      DKIO  = K1IT1
      XKRO  = K2RT2P-K2OT2P
      XKIO  = K2IT2P
```

```
      INCRO        - EFN   SOURCE STATEMENT  -  IFN(S)  -                01/15/71

      JO = 1
      IF (NDBLE.NE.0) JO = 2
      IF (LMS.EQ.0) GO TO  170
  160 USE3(IO,JO) = DKRI
      USE4(IO,JO) = DKII
      XUSE3(IO,JO)= XKRI
      XUSE4(IO,JO)= XKII
      GO TO 180
  170 USE1(IO,JO) = DKRO
      USE2(IO,JO) = DKIO
      XUSE1(IO,JO)= XKRO
      XUSE2(IO,JO)= XKIO
  180 CONTINUE
      XO = AX
      YO = AY
      ZO = AZ
      ZERO = 0.0
      XIIJR= 0.
      XIIJI= 0.
      DIIJR= 0.0
      DIIJI= 0.0
      PI    = 3.1415926
      XMULT =((XDELX1/(8.0*PI))
      IF ((YO.EQ.ZERO).AND.(ZO.EQ.ZERO))  GO TO 220
      IF    ((ZO.EQ.ZERO).AND.(SFN.EQ.ZERO))  GO TO 230
  190 ETAO1 = YO*CFN + ZO*SFN
      ZETO1 =-YO*SFN + ZO*CFN
      AZETO = ABS(ZETO1)
      IF (AZETO.LE.0.0001)  ZETO1 = 0.
  200 RISQX = ETAO1**2 + ZETO1**2
  210 ARE = (DKRI -2.*DKRC + DKRO)/(2.0*E2)
      AIM = (DKII -2.*DKIC + DKIO)/(2.0*E2)
      BRE = (DKRO - DKRI)/(2.0*EE)
      BIM = (DKIO - DKII)/(2.0*EE)
      CRE =  DKRC
      CIM =  DKIC
      GO TO 250
  220 ETAO1 = 0.0
      ZETO1 = 0.0
      RISQX = 0.0
      GO TO  210
  230 ETA°1  = YO*CFN
      ZETO1  = 0.
  240 RISQX  = ETAO1**2
      GO TO  210
  250 CONTINUE
      IF (AT1S.EQ.0.0)  GO TO 255
      CALL        IDF1 (EE,E2,AT2,ETAO1,ZETO1,ARE,AIM,BRE,BIM,CRE,CIM,
     1                  RISQX,XIIJR,XIIJI)                                  106
      DELR =XMULT*XIIJR
      DELI =XMULT*XIIJI
  255 CONTINUE
      IF (AT2S.EQ.0.0)  GO TO 260
      A2R  = (XKRI - 2.0*XKRC + XKRO)/(2.0*E2)
      A2I  = (XKII - 2.0*XKIC + XKIO)/(2.0*E2)
      B2R  = (XKRO - XKRI)/(2.0*EE)
```

```
      INCRO        -  EFN   SOURCE STATEMENT  -  IFN(S)  -                01/15/71

      B21   = (XKIO - XKII)/(2.0*EE)                                       INCR1670
      C2R   =  SKRC                                                        INCR1680
      C2I   =  AKIC                                                        INCR1690
      CALL        IOF2(ZE,E2,AT2,ETAOI,ZETOI,A2R,A2I,B2R,B2I,C2R,C2I,      INCR1700
     1              A1SQX,DIIJR,DIIJI)                                     INCR1710     110
      DELR = DELR + XMULT*DIIJR                                            INCR1720
      DELI = DELI + XMULT*DIIJI                                            INCR1730
  260 RETURN                                                               INCR1740
      END                                                                  INCR1750
```

```
      KERNEL       -  EFN   SOURCE STATEMENT  -  IFN(S)  -                01/15/71

      SUBROUTINE KERNEL(XO,YO,ZO,KR,BR,GAMS,GAMSIG,M,EPS,T1,T2)
      REAL    M, KR, KKR, KKI, IOOR, IOOI, JOOR, JOOI, I1OR, I1OI, I2OR3,KERN0020
     1        I2OI3, IOUR, IOUI, JOUR, JOUI, I1UR, I1UI, I2UR3, I2UI3,    KERN0030
     2        K1, MU1, MU, K2                                             KERN0040
      REAL    K1O,K2O,K1RT1,K1IT1,K2RT2P,K2IT2P,K1OT1,K2OT2P              KERN0050
      COMMON  /DLM/  K1O,K2O,K1RT1,K1IT1,K2RT2P,K2IT2P,K1OT1,K2OT2P,E2    KERN0060
   13 FORMAT  (1HO,4E15.6/)                                               KERN0070
      PI    = 3.1415926                                                   KERN0080
       PI2 = PI**2                                                        KERN0090
      K1O     = 0.0                                                       KERN0100
      K2O     = 0.0                                                       KERN0110
      K1RT1   = 0.0                                                       KERN0120
      K1IT1   = 0.0                                                       KERN0130
      K2RT2P  = 0.0                                                       KERN0140
      K2IT2P  = 0.0                                                       KERN0150
      K1OT1   = 0.0                                                       KERN0160
      K2OT2P  = 0.0                                                       KERN0170
      R1= SQRT (YO*YO+ZO*ZO)                                              KERN0180     2
      R1S = R1                                                            KERN0190
      IF   ( R1 )                200,100,200                              KERN0200
  100 IF   ( XO )                110,120,120                              KERN0210
  110 KKR=0.                                                              KERN0220
      KKI=0.                                                              KERN0230
      GO TO  905                                                          KERN0240
  120 C1= KR*XO/BR                                                        KERN0250
      T1= COS(GAMS-GAMSIG)                                                KERN0260     9
      KKR= 2.*(COS(C1)-1.)*T1                                             KERN0270     10
      KKI=-2.*SIN(C1)*T1                                                  KERN0280     11
      K1O     = 2.0                                                       KERN0290
      K1RT1   = 2.0*T1*COS(C1)                                            KERN0300     12
      K1IT1   =-2.0*T1*SIN(C1)                                            KERN0310     13
      K1OT1   = 2.0*T1                                                    KERN0320
      GO TO  905                                                          KERN0330
  200 C1=COS(GAMS)                                                        KERN0340     16
      C2=SIN(GAMS)                                                        KERN0350     17
      C3=COS(GAMSIG)                                                      KERN0360     18
      C4=SIN(GAMSIG)                                                      KERN0370     19
      T2P=(ZO*ZO*C1*C3+YO*YO*C2*C4-ZO*YO*(C2*C3+C1*C4))                   KERN0380
      T2 = T2P/E2                                                         KERN0390
      IF   ( ABS(T2)-EPS )                    210,220,220                 KERN0400
  210 ICMUZ=1                                                             KERN0410
      T1= COS(GAMS-GAMSIG)                                                KERN0420     23
      T2=0.                                                               KERN0430
      GO TO 300                                                           KERN0440
  220 T1= COS(GAMS-GAMSIG)                                                KERN0450     26
      IF   ( ABS(T1)-EPS )                    230,240,240                 KERN0460
  230 ICMUZ=2                                                             KERN0470
      T1=0.                                                               KERN0480
      GO TO 300                                                           KERN0490
  240 ICMUZ=3                                                             KERN0500
  300 BETA2 = (1.-M*M)                                                    KERN0510
      BIGR = SQRT (XO*XO+BETA2*R1S*R1S)                                   KERN0520     33
      K1= KR*R1/BR                                                        KERN0530
      MU1= (M*BIGR-XO)/ (BETA2*R1)                                        KERN0540
      MU=ABS(MU1)                                                         KERN0550
```

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      KERNEL      -  EFN    SOURCE STATEMENT  -  IFN(S)  -                          01/15/71

    1              +E*(R)O+E*R(1)))))))))))                              KERN1680
      R1   = R1S                                                         KERN1690
      C6= K1*MU                                                          KERN1700
      C1= SIN(C6)                                                        KERN1710     57
      C2= COS(C6)                                                        KERN1720     58
      C3= SQRT(1.+MU*MU)                                                 KERN1730     59
      C4= MU/C3                                                          KERN1740
      C5= C4/(1.+MU*MU)                                                  KERN1750
      GO TO  (430,440,430,430,440,430,500,500,500),ICHUZ                 KERN1760
  430 I1UR = C2*(1.-C4+K1*IOUI)-C1*K1*IOUR                               KERN1770
      I1UI =-C2*K1*IOUR-C1*(1.-C4+K1*IOUI)                               KERN1780
      GO TO  (500,440,440,460,440,440,500,500,500),ICHUZ                 KERN1790
  440 I2UR3 = C2*(2.*(1.-C4)-C5+K1*IOUI+K2*JOUR)+C1*(C6*(1.-C4)-K1*IOUR KERN1800
    1              +K2*JOUI)                                             KERN1810
      I2UI3 = C2*(C6*(1.-C4)-K1*IOUR+K2*JOUI)-C1*(2.*(1.-C4)-C5+K1*IOUI KERN1820
    1              +K2*JOUR)                                             KERN1830
      GO TO  (500,500,500,460,450,450,500,500,500),ICHUZ                 KERN1840
  450 I2UR3 = 2.0 * I20R3 - I2UR3                                        KERN1850
      IF  ( ICHUZ-6 )                      500,460,500                   KERN1860
  460 CAR = 2.*I1OR-I1UR                                                 KERN1870
      I1UR= CAR                                                          KERN1880
  500 DK1R=0.                                                            KERN1890
      DK1I=0.                                                            KERN1900
      DK2R=0.                                                            KERN1910
      DK2I=0.                                                            KERN1920
      C3=K1*MU1                                                          KERN1930
      C1=COS(C3)                                                         KERN1940     69
      C2=SIN(C3)                                                         KERN1950     70
      C3= M*R1/BIGR                                                      KERN1960
      C4=SQRT(1.+MU1*MU1)                                                KERN1970     71
      C5=KR*X0/BR                                                        KERN1980
      C6=COS(C5)                                                         KERN1990     72
      C7=SIN(C5)                                                         KERN2000     73
      GO TO (530,540,530,530,540,530,510,520,510),ICHUZ                  KERN2010
  510 I1UR=I1OR                                                          KERN2020
      I1UI=I1OI                                                          KERN2030
      IF  ( ICHUZ-7 )                      520,530,520                   KERN2040
  520 I2UR3= I20R3                                                       KERN2050
      I2UI3= I20I3                                                       KERN2060
      IF  ( ICHUZ-8 )                      530,540,530                   KERN2070
  530 CK1R = I1UR + C3*C1/C4                                             KERN2080
      CK1I = I1UI - C3*C2/C4                                             KERN2090
      K10  = 1.0 + X0/BIGR                                               KERN2100
      DK1R = CK1R*C6 + CK1I*C7                                           KERN2110
      DK1I = CK1I*C6 - CK1R*C7                                           KERN2120
      GO TO  (900,540,540,900,540,540,900,540,540),ICHUZ                 KERN2130
  540 C8=  (BETA2*(R1/BIGR)**2 + (2.+MU1*C3)/(C4*C4))*(-C3/C4)           KERN2140
      C9= ( K1*C3)*( C3/C4)                                              KERN2150
      CK2R = -I2UR3 + C8*C1 - C9*C2                                      KERN2160
      CK2I = -I2UI3 - C9*C1 - C8*C2                                      KERN2170
      K20  = -2.0 -X0*(2.0+BETA2*(R1/BIGR)**2)/BIGR                      KERN2180
      DK2R = CK2R*C6 + CK2I*C7                                           KERN2190
      DK2I = CK2I*C6 - CK2R*C7                                           KERN2200
  900 KKR = T1*DK1R + T2*DK2R                                            KERN2210
      KKI = T1*DK1I + T2*DK2I                                            KERN2220
      K1RT1  = T1 * DK1R                                                 KERN2230
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      KERNEL      -  EFN    SOURCE STATEMENT  -  IFN(S)  -                          01/15/71

      K1IT1  = T1 * CK1I                                                 KERN2240
      K2RT2P = T2P* DK2R                                                 KERN2250
      K2IT2P = T2P* DK2I                                                 KERN2260
      K10T1  = K10* T1                                                   KERN2270
      K20T2P = K20* T2P                                                  KERN2280
  905 CONTINUE                                                           KERN2290
      RETURN                                                             KERN2300
      END                                                                KERN2310
```

```
      IDF1         - EFN    SOURCE STATEMENT  -  IFN(S)  -                      01/15/71

      SUBROUTINE IDF1 (EE,E2,AT2,ETA01,ZET01,ARE,AIM,BRE,BIM,CRE,CIM,           IDF10010
     1                 RISQX,DIIJR,DIIJI)                                       IDF10020
   10 FORMAT  (1H0,    6E20.6/)                                                 IDF10030
      PARN = ETA01**2 - ZET01**2                                                IDF10040
      FACR = PARN*ARE + ETA01*BRE + CRE                                         IDF10050
      FACI = PARN*AIM + ETA01*BIM + CIM                                         IDF10060
      PARNR= BRE/2.0  + ETA01*ARE                                               IDF10070
      PARNI= BIM/2.0  + ETA01*AIM                                               IDF10080
      UP   = ((ETA01-EE)**2 + ZET01**2                                          IDF10090
      DOWN = ((ETA01+EE)**2 + ZET01**2                                          IDF10100
      ARG2 = UP/DOWN                                                            IDF10110
      ALARG2 = ALOG(ARG2)                                                       IDF10120     2
      TRM2R= PARNR * ALOG(ARG2)                                                 IDF10130     3
      TRM2I= PARNI * ALOG(ARG2)                                                 IDF10140     4
      TRM3R= 2.0*EE* ARE                                                        IDF10150
      TRM3I= 2.0*EE* AIM                                                        IDF10160
      AZET = ABS(ZET01)                                                         IDF10170
      IF (AZET.EQ.0.0)  GO TO 100                                               IDF10180
      TESTO= ABS((RISQX-E2)/(2.0*EE*AZET))                                      IDF10190
      IF (TESTO.LE.0.0001)  GO TO 110                                           IDF10200
      COEF = (2.0*EE)/(RISQX-E2)                                                IDF10210
      ARGA = COEF*ZET01                                                         IDF10220
      TEST = ABS(ARGA)                                                          IDF10230
      IF (TEST.LE.0.3)  GO TO 12C                                               IDF10240
      ARGT = COEF*AZET                                                          IDF10250
      ATANA= ATAN(ARGT)                                                         IDF10260    14
      FUNCT= ATANA/AZET                                                         IDF10270
      GO TO 170                                                                 IDF10280
  100 CONTINUE                                                                  IDF10290
      FUNCT= (2.0*EE)/(ETA01**2-E2)                                             IDF10300
      GO TO 170                                                                 IDF10310
  110 CONTINUE                                                                  IDF10320
      ALPHA= E2/ZET01**2                                                        IDF10330
      FUNCT= 0.0                                                                IDF10340
      GO TO 170                                                                 IDF10350
  120 CONTINUE                                                                  IDF10360
      S    = ARGA**2                                                            IDF10370
      SER  = 1./3.+S*(-1./5.+S*(1./7.+S*(-1./9.+S*(1./11.-S/13.))))             IDF10380
      ALPHA= E2*(COEF**2)*SER                                                   IDF10390
      FUNCT= COEF*(1.0-ALPHA*(ZET01**2)/E2)                                     IDF10400
  170 CONTINUE                                                                  IDF10410
      TRM1R= FACR * FUNCT                                                       IDF10420
      TRM1I= FACI * FUNCT                                                       IDF10430
      DIIJR= TRM1R + TRM2R + TRM3R                                              IDF10440
      DIIJI= TRM1I + TRM2I + TRM3I                                              IDF10450
      RETURN                                                                    IDF10460
      END                                                                       IDF10470
```

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      IDF2         - EFN    SOURCE STATEMENT  -  IFN(S)  -                      01/15/71

      SUBROUTINE IDF2(EE,E2,AT2,ETA01,ZET01,A2R,A2I,B2R,B2I,C2R,C2I,            IDF20010
     1                RISQX,DIIJR,DIIJI)                                        IDF20020
   10 FORMAT  (1H0,    6E20.6/)                                                 IDF20030
      AZET = ABS(ZET01)                                                         IDF20040
      TESTO= ABS((RISQX-E2)/(2.0*EE*AZET))                                      IDF20050
      DENO = RISQX-E2                                                           IDF20060
      PARN = ETA01**2 + ZET01**2                                                IDF20070
      FACR = PARN*A2R + ETA01*B2R + C2R                                         IDF20080
      FACI = PARN*A2I + ETA01*B2I + C2I                                         IDF20090
      ETA02=ETA01**2                                                            IDF20100
      ZET02= ZET01**2                                                           IDF20110
      IF (AZET.EQ.0.0)  GO TO 120                                               IDF20120
      TEST = ABS(DENO/(2.0*EE*ZET01))                                           IDF20130
      IF (TEST.GT.0.1)  GO TO 120                                               IDF20140
      DEN2 = (ETA01+EE)**2+ZET02                                                IDF20150
      DEN3 = (ETA01-EE)**2+ZET02                                                IDF20160
      FAC2A= RISQX*ETA01+(ETA02-ZET02)*EE                                       IDF20170
      FAC3A= RISQX*ETA01-(ETA02-ZET02)*EE                                       IDF20180
      FAC2B= RISQX+ETA01*EE                                                     IDF20190
      FAC3B= RISQX-ETA01*EE                                                     IDF20200
      TRM2R= (FAC2A*A2R+FAC2B*B2R+(ETA01+EE)*C2R)/DEN2                          IDF20210
      TRM2I= (FAC2A*A2I+FAC2B*B2I+(ETA01+EE)*C2I)/DEN2                          IDF20220
      TRM3R=-(FAC3A*A2R+FAC3B*B2R+(ETA01-EE)*C2R)/DEN3                          IDF20230
      TRM3I=-(FAC3A*A2I+FAC3B*B2I+(ETA01-EE)*C2I)/DEN3                          IDF20240
      IF (TESTO.LE.0.0001)  GO TO 110                                           IDF20250
      COEF = (2.0*EE)/(RISQX-E2)                                                IDF20260
      ARGA = COEF*ZET01                                                         IDF20270
      TESTT= ABS(ARGA)                                                          IDF20280
      IF (TESTT.GT.0.3)  GO TO 9C                                               IDF20290
      S    = ARGA**2                                                            IDF20300
      SER  = 1./3.+S*(-1./5.+S*(1./7.+S*(-1./9.+S*(1./11.-S/13.))))             IDF20310
      ALPHA= E2*(COEF**2)*SER                                                   IDF20320
      FUNCT= COEF*(1.0-ALPHA*(ZET01**2)/E2)                                     IDF20330
      GO TO 100                                                                 IDF20340
   90 CONTINUE                                                                  IDF20350
      ARGT = COEF*AZET                                                          IDF20360
      ATANA= ATAN(ARGT)                                                         IDF20370    16
      FUNCT= ATANA/AZET                                                         IDF20380
  100 CONTINUE                                                                  IDF20390
      TRM1R= FACR*FUNCT                                                         IDF20400
      TRM1I= FACI*FUNCT                                                         IDF20410
      DIIJR= (TRM1R + TRM2R + TRM3R)/(2.0*ZET02)                                IDF20420
      DIIJI= (TRM1I + TRM2I + TRM3I)/(2.0*ZET02)                                IDF20430
      GO TO 170                                                                 IDF20440
  110 CONTINUE                                                                  IDF20450
      FUNCT= 0.0                                                                IDF20460
      GO TO 100                                                                 IDF20470
  120 CONTINUE                                                                  IDF20480
      DENA = (ETA01+EE)**2 + ZET01**2                                           IDF20490
      DENB = (ETA01-EE)**2 + ZET01**2                                           IDF20500
      UP1R = 2.0*(E2*A2R + C2R)                                                 IDF20510
      UP1I = 2.0*(E2*A2I + C2I)                                                 IDF20520
      UP2R = 4.0*E2*ETA01*B2R                                                   IDF20530
      UP2I = 4.0*E2*ETA01*B2I                                                   IDF20540
      TRM1R= (UP1R *(RISQX+E2) + UP2R )/(DENA*DENB)                             IDF20550
```

```
      IDF2        -  EFN   SOURCE STATEMENT  -  IFN(S)  -                01/15/71

      TRM1I= (UP1I *(R1SQX+E2) + UP2I )/(DENA*DENB)                       IDF20560
      IF (AZET.EQ.0.0)  GO TO 130                                         IDF20570
      COEF = (2.0*EE)/(R1SQX-E2)                                          IDF20580
      ARGA = COEF*ZETOL                                                   IDF20590
      TESTT= ABS(ARGA)                                                    IDF20600
      IF (TESTT.GT.0.3)  GO TO 125                                        IDF20610
      S    = ARGA**2                                                      IDF20620
      SER  = 1./3.+S*(-1./5.+S*(1./7.+S*(-1./9.+S*(1./11.-S/13.))))       IDF20630
      ALPHA= E2*(COEF**2)*SER                                             IDF20640
      FUNCT= COEF*(1.0-ALPHA*(ZETOL**2)/E2)                               IDF20650
      GO TO 140                                                           IDF20660
  125 CONTINUE                                                            IDF20670
      ARGT= COEF*AZET                                                     IDF20680
      ATANA= ATAN(ARGT)                                                   IDF20690    30
      FUNCT= ATANA/AZET                                                   IDF20700
      ALPHA= (E2/ZETO2)*(1.0-FUNCT*(DENO/(2.0*EE)))                       IDF20710
      GO TO 140                                                           IDF20720
  130 CONTINUE                                                            IDF20730
      ALPHA= ((2.0*E2)/(ETAO2-E2))**2                                     IDF20740
  140 CONTINUE                                                            IDF20750
      TRM2R= -ALPHA*FACR/E2                                               IDF20760
      TRM2I= -ALPHA*FACI/E2                                               IDF20770
      DIIJR= EE*(TRM1R + TRM2R)/DENO                                      IDF20780
      DIIJI= EE*(TRM1I + TRM2I)/DENO                                      IDF20790
  170 CONTINUE                                                            IDF20800
      RETURN                                                              IDF20810
      END                                                                 IDF20820
```

```
      SNPDF       -  EFN   SOURCE STATEMENT  -  IFN(S)  -                01/19/71

      SUBROUTINE SNPDF(SL,CL,TL,SGS,CGS,SGR,CGR,XO,YO,ZO,EE,DIJ,BETA,CV)SNPD0010
      REAL    KR,KROBR                                                    SNPD0020
   10 FORMAT   (1HO,19X, 6F15.6//)                                        SNPD0030
   20 FORMAT  (1HO, 6F15.6/2X,6F15.6//)                                   SNPD0040
      CAVE = CV                                                           SNPD0050
      CLSGS = CL*SGS                                                      SNPD0060
      CLCGS = CL*CGS                                                      SNPD0070
      EX =EE*TL                                                           SNPD0080
      EY =EE*CGS                                                          SNPD0090
      EZ =EE*SGS                                                          SNPD0100
      XOB =  XO / BETA                                                    SNPD0110
      RIX = XOB+ EX                                                       SNPD0120
      RIY = YO + EY                                                       SNPD0130
      RIZ = ZO + EZ                                                       SNPD0140
      RIMAG = SQRT(RIX**2 + RIY**2 + RIZ**2)                              SNPD0150    2
      ROX = XOB- EX                                                       SNPD0160
      ROY = YO - EY                                                       SNPD0170
      ROZ = ZO - EZ                                                       SNPD0180
      ROMAG = SQRT(ROX**2 + ROY**2 + ROZ**2)                              SNPD0190    3
      CAB = (RIX*SL + RIY*CLCGS + RIZ*CLSGS)/RIMAG                        SNPD0200
      CBB = (ROX*CL + ROY*CLCGS + ROZ*CLSGS)/ROMAG                        SNPD0210
      CBI = -RIX/RIMAG                                                    SNPD0220
      CAO =  ROX/ROMAG                                                    SNPD0230
      RICAB = RIMAG*CAB                                                   SNPD0240
      DBX = RIX - RICAB*SL                                                SNPD0250
      DBY = RIY - RICAB*CLCGS                                             SNPD0260
      DBZ = RIZ - RICAB*CLSGS                                             SNPD0270
      DB2 = DBX**2 + DBY**2 + DBZ**2                                      SNPD0280
      DI2 = RIY**2 + RIZ**2                                               SNPD0290
      DO2 = ROY**2 + ROZ**2                                               SNPD0300
      ACAB = ABS(CAB)                                                     SNPD0310
      ACBB = ABS(CBB)                                                     SNPD0320
      IF (ACAB.GT..9999)GO TO 30                                          SNPD0330
      IF (ACBB.GT..9999)GO TO 30                                          SNPD0340
      CACB =(CAB - CBB)/DB2                                               SNPD0350
      GO TO  60                                                           SNPD0360
   30 IF (CAB*CBB)40,50,50                                                SNPD0370
   40 CACB = 0.                                                           SNPD0380
      GO TO 60                                                            SNPD0390
   50 CACB = 0.5*ABS((1./RIMAG**2)-(1./ROMAG**2))                         SNPD0400
   60 CONTINUE                                                            SNPD0410
      VBY = CACB * (DBX*CLSGS - DBZ*SL)                                   SNPD0420
      VBZ = CACB * (DBY*SL - DBX*CLCGS)                                   SNPD0430
      ONECBI = (1.0 - CBI)/DI2                                            SNPD0440
      VIY = ONECBI*RIZ                                                    SNPD0450
      VIZ = -ONECBI*RIY                                                   SNPD0460
      CAOONE = (1.0 + CAO)/DO2                                            SNPD0470
      VOY = -CAOONE*ROZ                                                   SNPD0480
      VOZ = CAOONE*ROY                                                    SNPD0490
      VX = DBZ*CLCGS - DBY*CLSGS                                          SNPD0500
      VY = VBY + VIY + VOY                                                SNPD0510
      VZ = VBZ + VIZ + VOZ                                                SNPD0520
      WW= VY*SGR - VZ*CGR                                                 SNPD0530
      DIJ = WW* CAVE / 25.132741                                          SNPD0540
   70 CONTINUE                                                            SNPD0550
```

```
SNPDP      - EFN   SOURCE STATEMENT  -  IFN(S)  -              01/15/71

RETURN                                                         SNPD0560
END                                                            SNPD0570
```

```
SSLECK     - EFN   SOURCE STATEMENT  -  IFN(S)  -              01/15/71

      SUBROUTINE SSLECK(NCNSM1,ND,NGUST)                               SSLE0010
      COMMON  /NTPS/  NTP1,NTP2,NTP3,NTP4,NTP5,NTP6,NTP7,NTP8,NTP9,NTP10SSLE0015
      DIMENSION  NSIZB(50,2) , LIM(50,3)                               SSLE0020
      DIMENSION  WR(130), WI(130)                                      SSLE0030
      COMPLEX    AUGMM(530), GUST(400), W(30,10)                       SSLE0040
   10 FORMAT (1H0,6E20.8)                                              SSLE0050
   20 FORMAT  (6F10.0)                                                 SSLE0060
      NFM1 = 0                                                         SSLE0065
      REWIND  NTP1                                                     SSLE0070    2
      REWIND  NTP3                                                     SSLE0080    3
      REWIND  NTP10                                                    SSLE0090    4
      READ  (NTP10) NSTRIP,NSIZB,LIM                                   SSLE0100    5
      DO  30    I = 1,130                                              SSLE0110
      WR(I) = 0.                                                       SSLE0120
   30 WI(I) = 0.                                                       SSLE0130
      DO  40   I = 1,530                                               SSLE0140
   40 AUGMM(I) = (0.,0.)                                               SSLE0150
      NCFLG = 0                                                        SSLE0160
      DO 50   I = 1,NSTRIP                                             SSLE0170
   50 NCFLG = NCFLG + NSIZB(I,1)                                       SSLE0180
      NT = NCNSM1 + NFM1                                               SSLE0190
      ND   = NCNSM1 + NFM1                                             SSLE0200
      IARN1  = NCNSM1 + 1                                              SSLE0210
      NC = NCFLG                                                       SSLE0220
      NN1 = ND + 1                                                     SSLE0230
      NN2 = ND + ND                                                    SSLE0240
      NN2P1 = NN2+1                                                    SSLE0250
      IF (NGUST.NE.0) ND = ND+1                                        SSLE0267
      NI = 4                                                           SSLE0270
      IF (NGUST.NE.0)  READ(NTP3)   GUST                               SSLE0280    43
      REWIND NI                                                        SSLE0290    45
      EPSI = .00001                                                    SSLE0300
      ALPHA = 1.                                                       SSLE0310
      PI = 3.14159265                                                  SSLE0320
   60 IN   = 0                                                         SSLE0330
      INP1 = IN + 1                                                    SSLE0340
      DO 190  K = 1, ND                                                SSLE0350
      READ  (NTP1) (AUGMM(I),  I=1,NCNSM1)                             SSLE0360    51
      IF (NFM1.EQ.0)  GO TO  70                                        SSLE0370
      READ  (NTP1) (AUGMM(I),  I=IARN1,ND)                             SSLE0380    58
   70 CONTINUE                                                         SSLE0390
      IF (K.EQ.1)  GO TO 150                                           SSLE0400
   80 DO 90 I = 1,NSTRIP                                               SSLE0410
      IF( INP1.LE. LIM(I,2) .AND. INP1.GE. LIM(I,1)) KK2= I            SSLE0420
   90 CONTINUE                                                         SSLE0430
      IF( KK2 .EQ. KK1) GO TO 100                                      SSLE0446
      READ  (NTP3)   W                                                 SSLE0450    70
      KK1 = KK2                                                        SSLE0460
      INL = 0                                                          SSLE0470
  100 DO 110    I = 1,NCFLG                                            SSLE0480
      WR(I) = 0.                                                       SSLE0490
  110 WI(I) = 0.                                                       SSLE0500
      INL = INL + 1                                                    SSLE0510
      IC2 = 0                                                          SSLE0520
      DO 120 I =1,KK2                                                  SSLE0530
```

```
      SSLECX      - EFN   SOURCE STATEMENT  -  IFN(S)  -                  01/15/71

      IC2 = IC2 + NSIZB(I,1)                                              SSLE0540
  120 CONTINUE                                                            SSLE0550
      IC1 = IC2 - NSIZB(KK2,1) + 1                                        SSLE0560
      DO 130  I = IC1,IC2                                                 SSLE0570
      IC = I - IC1 + 1                                                    SSLE0580
      WR(I) = REAL ( W(INL,IC))                                           SSLE0590
  130 WI(I) =AIMAG ( W(INL,IC))                                           SSLE0600
      DO 140    I = NW1,NW2                                               SSLE0610
      IW = I  - NT                                                        SSLE0620
      AUGMM(I) =-CMPLX(WR(IW),WI(IW))                                     SSLE0630
  140 CONTINUE                                                            SSLE0640
      GO TO 180                                                           SSLE0650
  150 READ  (NTP3)  W                                                     SSLE0660    115
      KK1= 1                                                              SSLE0670
      NCW = NSIZB(1,1)                                                    SSLE0680
      INL= 1                                                              SSLE0690
      DO 160  I = 1,NCW                                                   SSLE0700
      WR(I) = REAL(W(1,I))                                                SSLE0710
  160 WI(I) =AIMAG(W(1,I))                                                SSLE0720
      DO  170   I  = NW1,NW2                                              SSLE0730
      IW = I  - ND                                                        SSLE0740
  170 AUGMM(I) =-CMPLX(WR(IW),WI(IW))                                     SSLE0750
  180 CONTINUE                                                            SSLE0760
      IF (NGUST.NE.0)  AUGMM(NW2P1) = GUST(K)                             SSLE0770
      IN  =  IN + 1                                                       SSLE0780
      INP1=  IN + 1                                                       SSLE0790
  190 WRITE (NZ)   AUGMM                                                  SSLE0800    142
  200 RETURN                                                              SSLE0810
      END                                                                 SSLE0820
```

```
      CXSS        - EFN   SOURCE STATEMENT  -  IFN(S)  -                  01/15/71

      SUBROUTINE CXSS  (NCNSM1,ND,NGUST)                                  CXSS0010
      COMMON  /NTPS/  NTP1,NTP2,NTP3,NTP4,NTP5,NTP6,NTP7,NTP8,NTP9,NTP10CXSS0015
      DIMENSION  NSIZB(50,2), LIM(50,3)                                   CXSS0020
      COMPLEX    WX(400), GUST(400), W(30,10)                             CXSS0030
   10 FORMAT  (1H0,35X,10HCOLUMN NO.,I4,27H OF THE AIC-TYPE RHS-MATRIX/(CXSS0040
   20 FORMAT  (1H0,6E20.8)                                                CXSS0050
      NBOX = NCNSM1                                                       CXSS0052
      NPRI = 0                                                            CXSS0054
      REWIND  NTP3                                                        CXSS0060    3
      REWIND  NTP4                                                        CXSS0070    4
      REWIND  NTP10                                                       CXSS0080    5
      READ  (NTP10) NSTRIP,NSIZB,LIM                                      CXSS0090    6
      ND    = 0                                                           CXSS0100
      MDRUN= 0                                                            CXSS0110
      DO 50  K=1,NSTRIP                                                   CXSS0120
   50 ND    = ND+NSIZB(K,1)                                               CXSS0130
      IF (NGUST.EQ.0)  GO TO 60                                           CXSS0140
      ND    = ND+1                                                        CXSS0150
      READ  (NTP3) GUST                                                   CXSS0160    23
   60 CONTINUE                                                            CXSS0170
      WRITE (NTP4)  ND                                                    CXSS0180    25
      DO 300  K=1,NSTRIP                                                  CXSS0190
      NMODE= NSIZB(K,1)                                                   CXSS0200
      READ  (NTP3)  W                                                     CXSS0210    30
      L1    = LIM(K,1)                                                    CXSS0220
      L2    = LIM(K,2)                                                    CXSS0230
      DO 200  J=1,NMODE                                                   CXSS0240
      MDRUN= MDRUN+1                                                      CXSS0250
      DO 100  I=1,400                                                     CXSS0260
  100 WX(I)= (0.0,0.0)                                                    CXSS0270
      LW    = 0                                                           CXSS0280
      DO 150  L=L1,L2                                                     CXSS0290
      LW    = LW+1                                                        CXSS0300
      WX(L)= W(LW,J)                                                      CXSS0310
  150 CONTINUE                                                            CXSS0320
      IF (NPRI.NE.9)  GO TO 160                                           CXSS0330
      WRITE (6,10)  MDRUN                                                 CXSS0340    54
      WRITE (6,20)  (WX(I), I=1,NBOX)                                     CXSS0350    55
  160 CONTINUE                                                            CXSS0360
      WRITE (NTP4)  (WX(I),I=1,NBOX)                                      CXSS0370    60
  200 CONTINUE                                                            CXSS0380
  300 CONTINUE                                                            CXSS0390
      IF (NGUST.NE.0)  WRITE (NTP4)  (GUST(I), I=1,NBOX)                  CXSS0400    70
      RETURN                                                              CXSS0410
      END                                                                 CXSS0420
```

```
      SOLVIT     - EFN   SOURCE STATEMENT  -  IFN(S)  -                 01/15/71

      SUBROUTINE SOLVIT(NO,MO,KD,NI,NR,NO,NW,NPRI)                      SOLV0010
C                                                                       SOLV0020
C                                                                       SOLV0030
C     [illegible banner]                                                SOLV0040
C                                                                       SOLV0050
C                                                                       SOLV0060
C                                                                       SOLV0070
C                                                                       SOLV0080
C                                                                       SOLV0090
C                    - C O M P L E X -                                  SOLV0100
C          D I R E C T   M A T R I X   S O L U T I O N                  SOLV0110
C                                                                       SOLV0120
C     WRITTEN BY J. L. HESS * PROGRAMMED BY T. M. RIDDELL               SOLV0130
C                                                                       SOLV0140
C                                                                       SOLV0150
      COMPLEX  A( 4000)                                                 SOLV0160
      DIMENSION  RA(2, 4000)                                            SOLV0170
                                                                        SOLV0180
      EQUIVALENCE  (A(1),RA(1,1))                                       SOLV0190
C                                                                       SOLV0200
      LOGICAL  LAST                                                     SOLV0210
C                                                                       SOLV0220
    1  FORMAT (…TIME I6, 2H X I3, 15H MATRIX EXCEEDS I6, 7H WORDS.)     SOLV0230
    2 FORMAT (1H0,6E20.8)                                               SOLV0240
    3 FORMAT (1H0, 10HCOLUMN NO.,I6,2X,17HOF GAMMAS FOLLOWS.//)         SOLV0250
      [illegible]                                                       SOLV0260
      [illegible]                                                       SOLV0270
      [illegible]                                                       SOLV0280
      KORE = [illegible] / 2                                            SOLV0290
      [illegible]                                                       SOLV0300
      IF ([illegible] .LE. KORE) GO TO 5                                SOLV0310
      WRITE (6,  1 ) [illegible], KORE                                  SOLV0320   9
      STOP                                                              SOLV0330
    5 [illegible]                                                       SOLV0340
      REWIND [illegible]                                                SOLV0350   11
      [illegible]                                                       SOLV0360
      REWIND [illegible]                                                SOLV0370   12
      [illegible]                                                       SOLV0380
      REWIND [illegible]                                                SOLV0390   13
      [illegible]                                                       SOLV0400
      [illegible]                                                       SOLV0410
      NEL = [illegible]                                                 SOLV0420
C                                                                       SOLV0430
C - - CALCULATE THE MAXIMUM NO. OF ROWS, 'K'                            SOLV0440
C                                                                       SOLV0450
   10 K = (KORE - NEL) / NEL                                            SOLV0460
C                                                                       SOLV0470
C - - TEST TO SEE IF THE REST OF THE MATRIX WILL FIT IN CORE            SOLV0480
C                                                                       SOLV0490
      LAST = K .GE. [illegible]                                         SOLV0500
      IF (LAST) K = [illegible]                                         SOLV0510
C                                                                       SOLV0520
C - - READ 'K' ROWS OF THE AUGMENTED 'A' MATRIX                         SOLV0530
C                                                                       SOLV0540
   30 NT = 0                                                            SOLV0550
```

```
      SOLVIT     - EFN   SOURCE STATEMENT  -  IFN(S)  -                 01/15/71

      DO 40 IB = 1, K                                                   SOLV0560
      NS = NT + 1                                                       SOLV0570
      NT = NT + NEL                                                     SOLV0580
   40 READ (NIN) (A(IO), IO = NS, NT)                                   SOLV0590
C                                                                       SOLV0600
C - - CHECK TO SEE IF WE WERE UNLUCKY ENOUGH TO END UP WITH ONLY ONE ROWSOLV0610
C                                                                       SOLV0620   28
      IF (K .EQ. 1) GO TO 90                                            SOLV0630
C                                                                       SOLV0640
C - - 'K' IS GREATER THAN '1' SO WE CAN START THE TRIANGULARIZATION     SOLV0650
C                                                                       SOLV0660
      NELP1 = NEL + 1                                                   SOLV0670
      NS = - NEL                                                        SOLV0680
      NELP2 = NELP1 + 1                                                 SOLV0690
C                                                                       SOLV0700
C - - FORM THE 'TRAPEZOIDAL' ARRAY  (B)                                 SOLV0710
C                                                                       SOLV0720
      DO 50 IB = 2, K                                                   SOLV0730
      NP = NELP2 - IB                                                   SOLV0740
      NS = NS + NELP1                                                   SOLV0750
      NT = NS                                                           SOLV0760
      DO 50 IO = IB, K                                                  SOLV0770
      NT = NT + NEL                                                     SOLV0780
      MN = NT                                                           SOLV0790
      NB = NS                                                           SOLV0800
C                                                                       SOLV0810
C     A(NT) = -A(NT) / A(NS)                                            SOLV0820
C                                                                       SOLV0830
      TEMPR = REAL(A(NT))                                               SOLV0840
      DENOM = - ( REAL(A(NS)) ** 2 + AIMAG(A(NS)) ** 2 )                SOLV0850
      RA(1,NT) = (TEMPR       * REAL(A(NS)) + AIMAG(A(NT)) *            SOLV0860
     *            AIMAG(A(NS))) / DENOM                                 SOLV0870
      RA(2,NT) = (AIMAG(A(NT)) * REAL(A(NS)) - TEMPR *                  SOLV0880
     *            AIMAG(A(NS))) / DENOM                                 SOLV0890
C                                                                       SOLV0900
      DO 50 NF = 2, NP                                                  SOLV0910
      MN = MN + 1                                                       SOLV0920
      NB = NB + 1                                                       SOLV0930
C                                                                       SOLV0940
C  50 A(MN) = A(MN) + A(NT) * A(NB)                                     SOLV0950
C                                                                       SOLV0960
      RA(1,MN) = RA(1,MN) + REAL(A(NT)) * REAL(A(NB)) -                 SOLV0970
     *            AIMAG(A(NT)) * AIMAG(A(NB))                           SOLV0980
C                                                                       SOLV0990
   50 RA(2,MN) = RA(2,MN) + REAL(A(NT)) * AIMAG(A(NB)) +                SOLV1000
     *            AIMAG(A(NT)) * REAL(A(NB))                            SOLV1010
C                                                                       SOLV1020
      IF (LAST) GO TO 90                                                SOLV1030
C                                                                       SOLV1040
C - - WRITE THE 'TRAPEZOIDAL' MATRIX ON TAPE                            SOLV1050
C                                                                       SOLV1060
      NT = 0                                                            SOLV1070
      NP = NEL                                                          SOLV1080
      NS = - NEL                                                        SOLV1090
      DO 60 IO = 1, K                                                   SOLV1100
      NS = NS + NELP1                                                   SOLV1110
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      SOLVIT    - EFN   SOURCE STATEMENT  -  IFN(S)  -                  01/15/71

      NT = NT + NEL                                                      SOLV1120
      WRITE (NT) NP, (A(IB), IB = NS, NT)                                SOLV1130   94
   60 NP = NP - 1                                                        SOLV1140
      NP = NP - M                                                        SOLV1150
      NS = KORE - NEL + 1                                                SOLV1160
C                                                                        SOLV1170
C - - READ ANOTHER ROW                                                   SOLV1180
C                                                                        SOLV1190
      DO 60 IB = 1, NP                                                   SOLV1200
      READ (NIN) (A(IB), IB = NS, KORE)                                  SOLV1210
C                                                                        SOLV1220
C - - MODIFY THIS ROW BY THE 'TRAPEZOIDAL' ARRAY                         SOLV1230
C                                                                        SOLV1240   107
      NT = 1                                                             SOLV1250
      MM = NS                                                            SOLV1260
      DO 70 ID = 1, K                                                    SOLV1270
      NB = NT                                                            SOLV1280
      NF = MM + 1                                                        SOLV1290
C                                                                        SOLV1300
C     A(MM) = -A(MM) / A(NT)                                             SOLV1310
C                                                                        SOLV1320
      TEMPR = REAL(A(MM))                                                SOLV1330
      DENOM = - (REAL(A(NT)) ** 2 + AIMAG(A(NT)) ** 2)                   SOLV1340
      RA(1,MM) = (TEMPR       * REAL(A(NT)) + AIMAG(A(MM)) *             SOLV1350
     *           AIMAG(A(NT))) / DENOM                                   SOLV1360
      RA(2,MM) = (AIMAG(A(MM)) * REAL(A(NT)) - TEMPR *                   SOLV1370
     *           AIMAG(A(NT))) / DENOM                                   SOLV1380
C                                                                        SOLV1390
      DO 65 NN = NF, KORE                                                SOLV1400
      NB = NB + 1                                                        SOLV1410
C                                                                        SOLV1420
C  65 A(NN) = A(NN) + A(MM) * A(NB)                                      SOLV1430
C                                                                        SOLV1440
      RA(1,NN) = RA(1,NN) + REAL(A(MM)) * REAL(A(NB)) -                  SOLV1450
     *           AIMAG(A(MM)) * AIMAG(A(NB))                             SOLV1460
C                                                                        SOLV1470
   65 RA(2,NN) = RA(2,NN) + REAL(A(MM)) * AIMAG(A(NB)) +                 SOLV1480
     *           AIMAG(A(MM)) * REAL(A(NB))                              SOLV1490
C                                                                        SOLV1500
      MM = NF                                                            SOLV1510
   70 NT = NT + NELP1                                                    SOLV1520
C                                                                        SOLV1530
C - - WRITE THE MODIFIED ROW ON TAPE                                     SOLV1540
C                                                                        SOLV1550
   80 WRITE (NOUT)      (A(NT), NT = MM, KORE)                           SOLV1560   149
      REWIND NOUT                                                        SOLV1570   155
      REWIND NIN                                                         SOLV1580
C                                                                        SOLV1590
C - - SWITCH THE TAPES                                                   SOLV1600
C                                                                        SOLV1610   156
      NT = NIN                                                           SOLV1620
      NIN = NOUT                                                         SOLV1630
      NOUT = NT                                                          SOLV.640
C                                                                        SOLV1650
C - - RE-CALCULATE ROW LENGTH AND LOOP BACK                              SOLV1660
C                                                                        SOLV1670
```

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      SOLVIT    - EFN   SOURCE STATEMENT  -  IFN(S)  -                  01/15/71

      NEL = NEL - K                                                      SOLV1680
      NN = NEL                                                           SOLV1690
      GO TO 10                                                           SOLV1700
C                                                                        SOLV1710
C - - REWIND ALL TAPES                                                   SOLV1720
C                                                                        SOLV1730
   90 REWIND  NT                                                         SOLV1740   162
      REWIND NIN                                                         SOLV1750   163
      REWIND NOUT                                                        SOLV1760
C                                                                        SOLV1770
C - - CONDENSE THE MATRIX                                                SOLV1780
C                                                                        SOLV1790   164
      NN = NEL                                                           SOLV1800
      NL = NELP1                                                         SOLV1810
      IF (K .EQ. 1) GO TO 105                                            SOLV1820
      NS = 1                                                             SOLV1830
      NT = NEL                                                           SOLV1840
      DO 100 IB = 2, K                                                   SOLV1850
      NS = NS + NELP1                                                    SOLV1860
      NT = NT + NEL                                                      SOLV1870
      DO 100 IO = NS, NT                                                 SOLV1880
      A(NL) = A(IO)                                                      SOLV1890
  100 NL = NL + 1                                                        SOLV1900
  105 N1 = KORE - K * M + 1                                              SOLV1910
C                                                                        SOLV1920
C - - THERE, NOW WE CAN START THE BACK-SOLUTION                          SOLV1930
C * * NOTE..THE FIRST AVAILABLE LOCATION FOR THE SOLUTIONS IS A(N1)      SOLV1940
C                                                                        SOLV1950
      NREM = N                                                           SOLV1960
      NEL = NPM                                                          SOLV1970
      LAST = K .EQ. N                                                    SOLV1980
      NPASS = 0                                                          SOLV1990
C                                                                        SOLV2000
C - - SOLVE FOR THE ANSWERS CORRESPONDING TO "K" ROWS                    SOLV2010
C                                                                        SOLV2020
  110 KM1 = K - 1                                                        SOLV2030
      KP1 = K + 1                                                        SOLV2040
      NS = NL - MP1                                                      SOLV2050
      NPASS = NPASS + 1                                                  SOLV2060
      DO 130 MM = 1, M                                                   SOLV2070
      NF = NS + MM                                                       SOLV2080
C                                                                        SOLV2090
C     A(NF) = A(NF) / A(NS)                                              SOLV2100
C                                                                        SOLV2110
      TEMPR = REAL(A(NF))                                                SOLV2120
      DENOM = REAL(A(NS)) ** 2 + AIMAG(A(NS)) ** 2                       SOLV2130
      RA(1,NF) = (TEMPR       * REAL(A(NS)) + AIMAG(A(NF)) *             SOLV2140
     *           AIMAG(A(NS))) / DENOM                                   SOLV2150
      RA(2,NF) = (AIMAG(A(NF)) * REAL(A(NS)) - TEMPR *                   SOLV2160
     *           AIMAG(A(NS))) / DENOM                                   SOLV2170
C                                                                        SOLV2180
      NT = NS                                                            SOLV2190
      IF (KM1 .EQ. 0) GO TO 130                                          SOLV2200
      DO 125 IB = 1, KM1                                                 SOLV2210
      NF = NF - IB - M                                                   SOLV2220
      NT = NT - MP1 - IB                                                 SOLV2230
```

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      SOLVIT      - EFN   SOURCE STATEMENT  -  IFN(S)  -                01/15/71

C                                                                    SOLV2240
C     SUM = 0.0                                                      SOLV2250
C                                                                    SOLV2260
      SUMR = 0.0                                                     SOLV2270
      SUMI = 0.0                                                     SOLV2280
C                                                                    SOLV2290
      NP = NF                                                        SOLV2300
      N2 = NP1 + IB                                                  SOLV2310
      DO 120 IO = 1, IB                                              SOLV2320
      NN = NT + IO                                                   SOLV2330
      NP = NP + N2 - IO                                              SOLV2340
C                                                                    SOLV2350
C 120 SUM = SUM + A(NN) * A(NP)                                      SOLV2360
C                                                                    SOLV2370
      SUMR = SUMR + REAL(A(NN)) * REAL(A(NP)) - AIMAG(A(NN)) *       SOLV2380
     *        AIMAG(A(NP))                                           SOLV2390
C                                                                    SOLV2400
  120 SUMI = SUMI + REAL(A(NN)) * AIMAG(A(NP)) + AIMAG(A(NN)) *      SOLV2410
     *        REAL(A(NP))                                            SOLV2420
C                                                                    SOLV2430
C 125 A(NF) = (A(NF) - SUM) / A(NT)                                  SOLV2440
C                                                                    SOLV2450
      DENOM = REAL(A(NT)) ** 2 + AIMAG(A(NT)) ** 2                   SOLV2460
C                                                                    SOLV2470
      TEMPR = REAL(A(NF)) - SUMR                                     SOLV2480
      TEMPI = AIMAG(A(NF)) - SUMI                                    SOLV2490
C                                                                    SOLV2500
      BA(1,NF) = (TEMPR * REAL(A(NT)) + TEMPI * AIMAG(A(NT))) / DENOM  SOLV2510
  125 BA(2,NF) = (TEMPI * REAL(A(NT)) - TEMPR * AIMAG(A(NT))) / DENOM  SOLV2520
C                                                                    SOLV2530
  130 CONTINUE                                                       SOLV2540
C                                                                    SOLV2550
C - - MOVE THE SOLUTIONS TO CONTIGUOUS LOCATIONS STARTING AT A(N1)   SOLV2560
C                                                                    SOLV2570
      N1 = KORE + 1                                                  SOLV2580
      DO 140 MM = 1, K                                               SOLV2590
      DO 135 NN = 1, M                                               SOLV2600
      NL = NL - 1                                                    SOLV2610
      N1 = N1 - 1                                                    SOLV2620
  135 A(N1) = A(NL)                                                  SOLV2630
  140 NL = NL - NN                                                   SOLV2640
C                                                                    SOLV2650
C - - WRITE THE SOLUTIONS ON TAPE                                    SOLV2660
C                                                                    SOLV2670
      WRITE (NIN) K                                                  SOLV2680    265
      NS = N1 - 1                                                    SOLV2690
      DO 145 MM = 1, K                                               SOLV2700
      NT = NS + MM                                                   SOLV2710
  145 WRITE ( NIN ) (A(IO), IO = NT, KORE, K)                        SOLV2720
C                                                                    SOLV2730
C - - TEST IF THIS IS THE LAST PASS                                  SOLV2740
C                                                                    SOLV2750    270
      IF (LAST) GO TO 200                                            SOLV2760
C                                                                    SOLV2770
C - - WE MUST NOW MODIFY THE TRIANGULAR MATRIX TO REFLECT THE EFFECT OF SOLV2780
C     THE SOLUTIONS OBTAINED SO FAR  (EQ 7))                         SOLV2790
```

```
      SOLVIT      - EFN   SOURCE STATEMENT  -  IFN(S)  -                01/15/71

C * * NOTE..LOCATIONS A(1) TO A(N1-1) ARE NOW FREE TO USE            SOLV2800
C                                                                    SOLV2810
C - - CALCULATE THE NEXT VALUES OF 'NEL' AND 'NREM'                  SOLV2820
C                                                                    SOLV2830
      NELOLD = NEL                                                   SOLV2840
      KOLD = K                                                       SOLV2850
      NEL = NEL - K                                                  SOLV2860
      NREM = NREM - K                                                SOLV2870
C                                                                    SOLV2880
C - - NOW APPLY THE INCREDIBLE FORMULA FOR THE NEW 'K'               SOLV2890
C                                                                    SOLV2900
      K = (-4 * M - 1) / 2 + IFIX(SQRT(0.25 + FLOAT((4 * M + 2) * M +  SOLV2910
     1 2 * (KORE - NELOLD))))                                        SOLV2920    284
      NROW = NREM - K + 1                                            SOLV2930
      IF (K .LT. NREM) GO TO 150                                     SOLV2940
      LAST = .TRUE.                                                  SOLV2950
      NROW = 1                                                       SOLV2960
      K = NREM                                                       SOLV2970
  150 NS = 1                                                         SOLV2980
      NT =  ELOLD + 1                                                SOLV2990
C                                                                    SOLV3000
C - - READ IN THE ROWS TO BE MODIFIED                                SOLV3010
C                                                                    SOLV3020
      DO 190 IB = 1, NREM                                            SOLV3030
      NT = NT - 1                                                    SOLV3040
      IF (IB .LE. NROW) GO TO 160                                    SOLV3050
      NS = NS + NN                                                   SOLV3060
      NT = NT + NN                                                   SOLV3070
  160 READ ( MT ) NN, (A(IO), IO = NS, NT)                           SOLV3080    302
      NP = N1 - 1                                                    SOLV3090
      NF = NT - M - KM1                                              SOLV3100
      NN = NN - KOLD                                                 SOLV3110
      DO 170 MM = 1, M                                               SOLV3120
      N2 = NF                                                        SOLV3130
      NA = NP + MM                                                   SOLV3140
      NB = NA                                                        SOLV3150
C                                                                    SOLV3160
C     SUM = 0.0                                                      SOLV3170
C                                                                    SOLV3180
      SUMR = 0.0                                                     SOLV3190
      SUMI = 0.0                                                     SOLV3200
C                                                                    SOLV3210
      DO 165 IO = 1, KOLD                                            SOLV3220
C                                                                    SOLV3230
C     SUM = SUM + A(N2) * A(NA)                                      SOLV3240
C                                                                    SOLV3250
      SUMR = SUMR + REAL(A(N2)) * REAL(A(NA)) - AIMAG(A(N2)) *       SOLV3260
     *        AIMAG(A(NA))                                           SOLV3270
      SUMI = SUMI + REAL(A(N2)) * AIMAG(A(NA)) + AIMAG(A(N2)) *      SOLV3280
     *        REAL(A(NA))                                            SOLV3290
C                                                                    SOLV3300
      N2 = N2 + 1                                                    SOLV3310
  165 NA = NA + M                                                    SOLV3320
      N2 = N2 + NN - 1                                               SOLV3330
C                                                                    SOLV3340
C 170 A(N2) = A(N2) - SUM                                            SOLV3350
```

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         SOLVIT      - EFN   SOURCE STATEMENT  -  IFN(S)  -         01/15/71

C                                                                   SOLV3360
      [illegible]                                                   SOLV3370
  170 [illegible]                                                   SOLV3380
C                                                                   SOLV3390
C - - WRITE THE MODIFIED ROW ON TAPE OR CONDENSE THE ROW             SOLV3400
C                                                                   SOLV3410
      [illegible]                                                   SOLV3420
      [illegible]                                                   SOLV3430
      [illegible]                                                   SOLV3440
      WRITE [illegible]                                             SOLV3450   340
      GO TO [illegible]                                             SOLV3460
  175 [illegible]                                                   SOLV3470
      DO [illegible]                                                SOLV3480
      [illegible]                                                   SOLV3490
  180 [illegible]                                                   SOLV3500
  190 CONTINUE                                                      SOLV3510
      REWIND [illegible]                                            SOLV3520   341
      REWIND [illegible]                                            SOLV3530
C                                                                   SOLV3540
C - - SWITCH THE TAPES                                              SOLV3550
C                                                                   SOLV3560   342
      [illegible]                                                   SOLV3570
      [illegible]                                                   SOLV3580
      [illegible]                                                   SOLV3590
C                                                                   SOLV3600
C -   LOOP BACK THRU THE SOLUTION                                   SOLV3610
C                                                                   SOLV3620
      [illegible]                                                   SOLV3630
      GO TO 110                                                     SOLV3640
C                                                                   SOLV3650
C - - START TO WRAP IT UP                                           SOLV3660
C                                                                   SOLV3670
  200 [illegible]                                                   SOLV3680   367
      REWIND [illegible]                                            SOLV3690   368
      [illegible]                                                   SOLV3700
C                                                                   SOLV3710
C * * NOTE.. AT THIS POINT ALL LOCATIONS, A(1) THRU [illegible] ARE FREE SOLV3720
C                                                                   SOLV3730
      DO 220 [illegible]                                            SOLV3740
      READ [illegible]                                              SOLV3750   372
      [illegible]                                                   SOLV3760
      [illegible]                                                   SOLV3770
      [illegible]                                                   SOLV3780
C                                                                   SOLV3790
C - - READ IN THE SOLUTIONS                                         SOLV3800
C                                                                   SOLV3810
      DO 210 [illegible]                                            SOLV3820
      READ [illegible]                                              SOLV3830   378
      [illegible]                                                   SOLV3840
  210 [illegible]                                                   SOLV3850
  220 [illegible]                                                   SOLV3860
C                                                                   SOLV3870
C - - WRITE THE SOLUTIONS ON TAPE                                   SOLV3880
C                                                                   SOLV3890
      [illegible]                                                   SOLV3900
      DO 230 [illegible]                                            SOLV3910
```

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         SOLVIT      - EFN   SOURCE STATEMENT  -  IFN(S)  -         01/15/71

      NS = NT + 1                                                   SOLV3920
      NT = NT + N                                                   SOLV3930
      IF (NPR1.EQ.0) GO TO 230                                      SOLV3940
      WRITE (6,3) IC                                                SOLV3950   398
      WRITE (6,2) (A(NN), NN = NS, NT)                              SOLV3960   399
  230 WRITE (NW) (A(NN), NN = NS, NT)                               SOLV3970
C                                                                   SOLV3980   404
  300 FORMAT (4H0THE I5, 2H X I5, 12H MATRIX WITH I4, 35H RIGHT SIDES WASOLV3990
     1S SOLVED DIRECTLY IN F8.3, 9H MINUTES. )                      SOLV4000
      RETURN                                                        SOLV4010
      END                                                           SOLV4020
```

```
      QUAS        - IFN   SOURCE STATEMENT  -  IFN(S)  -                    01/15/71

      SUBROUTINE QUAS  (ND,MD,NP,NI,NN,NC,NAT,QUALTAPE,RHSTAP,NPOL)           QUAS0005
C     ***   COMPLEX    MALVET       QUASI INVERSE                            QUAS0010
C                                                                            QUAS0020
C            ****   ***/  *****  *****  *       ***/         *               QUAS0030
C            *   *  * /*    *    *      *       * /*      ******             QUAS0040
C     ****   ****   * / *   *    ***    *       * / *  ****    * *           QUAS0050
C            *      */  *   *    *      *       */  *        ***             QUAS0060
C            *      /***    *    *      *****   /***         * *             QUAS0070
C                                                                            QUAS0080
C              D I R E C T   M A T R I X   S O L U T I O N                   QUAS0090
C                                                                            QUAS0100
C*** [illegible] IS THE TAPE THE [illegible] MATRIX WILL BE PUT ON           QUAS0110
C*** [illegible] IS THE TAPE THAT THE RIGHT HAND SIDES ARE INPUT ON          QUAS0120
      COMPLEX   [illegible]                                                  QUAS0130
      INTEGER   [illegible]                                                  QUAS0140
C                                                                            QUAS0150
C                                                                            QUAS0160
      LOGICAL  [illegible]                                                   QUAS0170
      LOGICAL  [illegible]                                                   QUAS0180
      LOGICAL  [illegible]                                                   QUAS019C
C                                                                            QUAS0200
    2 FORMAT  ([illegible])                                                  QUAS0202
    3 FORMAT  ([illegible] CARDS FOLLOWS.//)                                 QUAS0204
   11 FORMAT  ([illegible])                                                  QUAS0210
    1 CONTINUE                                                               QUAS0220
      REWIND [illegible]                                                     QUAS0230      1
      READ  [illegible]                                                      QUAS0240      2
      [illegible]                                                            QUAS0250
      REWIND [illegible]                                                     QUAS0260      4
      REWIND [illegible]                                                     QUAS0270      5
      [illegible]                                                            QUAS0280
      [illegible]                                                            QUAS0290
C*** [illegible] IF THERE ARE NO [illegible] TO BE PROCESSED THIS RUN         QUAS0300
      IF([illegible] .NE. 0 )GO TO [illegible]                               QUAS0310
      [illegible]                                                            QUAS0320
      GO TO [illegible]                                                      QUAS0330
    5 REWIND [illegible]                                                     QUAS0340     12
      [illegible]                                                            QUAS0350     13
    6 [illegible]                                                            QUAS0360
      [illegible]                                                            QUAS0370
      [illegible]                                                            QUAS0380
      IF ([illegible] .GT. [illegible]) RETURN                               QUAS0390
      [illegible]                                                            QUAS0400
      [illegible]                                                            QUAS0410
      [illegible]                                                            QUAS0420
      REWIND [illegible]                                                     QUAS0430     23
      [illegible]                                                            QUAS0440
      REWIND [illegible]                                                     QUAS0450     24
      [illegible]                                                            QUAS0460
      [illegible]                                                            QUAS0470     25
      [illegible]                                                            QUAS0480
      [illegible]                                                            QUAS0490
      [illegible]                                                            QUAS0500
C                                                                            QUAS0510
C - - CALCULATE THE [illegible] NO. OF ROWS, [illegible]                     QUAS0520
```

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      QUAS        - IFN   SOURCE STATEMENT  -  IFN(S)  -                    01/15/71

                                                                             QUAS0530
   10 R = (KORE - NELI / NEL                                                 QUAS0540
C                                                                            QUAS0550
C - - TEST TO SEE IF THE REST OF THE MATRIX WILL FIT IN CORE                 QUAS0560
C                                                                            QUAS0570
      LAST = R .GE. NN                                                       QUAS0580
      IF( .NOT. LAST ) GO TO 30                                              QUAS0590
      R = NN                                                                 QUAS0600
      B = 3 * NMAX**2                                                        QUAS0610
      C = 2 * (1 + NMAX - KORE )                                             QUAS0620
      RTEMP = ( -B + SQRT(B**2  - 4.0* C )  )  / 2.0                         QUAS0630     36
      IF(RTEMP .GE. R)GO TO 30                                               QUAS0640
C                                                                            QUAS0650
C***   *  WE MUST REDUCE THE FINAL R                                         QUAS0660
C                                                                            QUAS0670
      R = RTEMP                                                              QUAS0680
      LAST = .FALSE.                                                         QUAS0690
C                                                                            QUAS0700
C - - READ 'R' ROWS OF THE AUGMENTED 'A' MATRIX                              QUAS0710
C                                                                            QUAS0720
   30 NT = C                                                                 QUAS0730
      DO 40 IR = 1, R                                                        QUAS0740
      NS = NT + 1                                                            QUAS0750
      NT = ST + NEL                                                          QUAS0760
   40 READ (NIN) (A(IQ), IQ = NS, NT)                                        QUAS0780
C                                                                            QUAS0790
C - - CHECK TO SEE IF WE WERE UNLUCKY ENOUGH TO END UP WITH ONLY ONE ROWQUAS0800
C                                                                            QUAS0810     48
      IF (R .EQ. 1) GO TO 90                                                 QUAS0820
C                                                                            QUAS0830
C - - 'R' IS GREATER THAN '1' SO WE CAN START THE TRIANGULARIZATION          QUAS0840
C                                                                            QUAS0850
      NELP1 = NEL + 1                                                        QUAS0860
      NS = - NEL                                                             QUAS0870
      NELP2 = NELP1 + 1                                                      QUAS0880
C                                                                            QUAS0890
C - - FORM THE 'TRAPEZOIDAL' ARRAY (R)                                       QUAS0900
C                                                                            QUAS0910
      DO 50 IR = 2, R                                                        QUAS0920
      NP = NELP2 - IR                                                        QUAS0930
      NS = NS + NELP1                                                        QUAS0940
      NT = NS                                                                QUAS0950
      DO 50 IC = IR, R                                                       QUAS0960
      NT = NT + NEL                                                          QUAS0970
      NN = NT                                                                QUAS0980
      NB = NS                                                                QUAS0990
      A(NT) = A(NT) / A(NS)                                                  QUAS1000
      DO 50 NF = 2, NP                                                       QUAS1010
      NN = NN + 1                                                            QUAS1020
      NB = NB + 1                                                            QUAS1030
   50 A(NN) = A(NN) - A(NT) * A(NB)                                          QUAS1040
C*** ***WRITE PART OF THE MATRIX ON LTAPE    (TRIANGULAR PART).               QUAS1050
      WRITE (LTAPE)(A                                                        QUAS1060     86
      LBEG =NELP1                                                            QUAS1070
      KR1 = R - 1                                                            QUAS1080
      DO 55 IR = 1,KR1                                                       QUAS1090
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      QUAS        - EFN   SOURCE STATEMENT  -  IFN(S)  -                01/15/71

      LEND = LBEG + IB- 1                                            QUAS1100
      WRITE (LTAPE) ( A(L),L=LBEG,LEND)                              QUAS1110    92
   55 LBEG = LBEG + NN                                               QUAS1120
C                                                                    QUAS1130
C - - WRITE THE 'TRAPEZOIDAL' MATRIX ON TAPE                         QUAS1140
C                                                                    QUAS1150
      NT = 0                                                         QUAS1160
      NP = NEL                                                       QUAS1170
      NS = - NEL                                                     QUAS1180
      DO 60 ID = 1, K                                                QUAS1190
      NS = NS + NELP1                                                QUAS1200
      NT = NT + NEL                                                  QUAS1210
      WRITE (NT1) NP, (A(IB), IB = NS, NT)                           QUAS1220   108
   60 NP = NP - 1                                                    QUAS1230
      IF (LAST) GO TO 90                                             QUAS1240
      NP = NP - K                                                    QUAS1250
      NS = KORE - NEL + 1                                            QUAS1260
C                                                                    QUAS1270
C - - READ ANOTHER ROW                                               QUAS1280
C                                                                    QUAS1290
      DO 80 IC = 1, NP                                               QUAS1300
      READ (NIN) (A(IB), IB = NS, KORE)                              QUAS1310
C                                                                    QUAS1320
C - - MODIFY THIS ROW BY THE 'TRAPEZOIDAL' ARRAY                     QUAS1330
C                                                                    QUAS1340   124
      NT = 1                                                         QUAS1350
      NN = NS                                                        QUAS1360
      DO 70 IP = 1, K                                                QUAS1370
      ND = NT                                                        QUAS1380
      NF = NN + 1                                                    QUAS1390
      A(NN) = A(NN) / A(NT)                                          QUAS1400
      DO 65 MM = NF, KORE                                            QUAS1410
      ND = ND + 1                                                    QUAS1420
   65 A(MM) = A(MM) - A(NN) * A(ND)                                  QUAS1430
      NN = NF                                                        QUAS1440
   70 NT = NT + NELP1                                                QUAS1450
C                                                                    QUAS1460
C - - WRITE THE MODIFIED ROW ON TAPE                                 QUAS1470
C                                                                    QUAS1480
C*** ***WRITE REST OF LMATRIX ON LTAPE                               QUAS1490
      NNM1 = NN - 1                                                  QUAS1500
      WRITE(LTAPE)(A(J),J=NS,NNM1)                                   QUAS1510   149
   80 WRITE (NOUT)     (A(NT), NT = NN, KORE)                        QUAS1520   154
      REWIND NOUT                                                    QUAS1530   160
      REWIND NIN                                                     QUAS1540
C                                                                    QUAS1550
C - - SWITCH THE TAPES                                               QUAS1560
C                                                                    QUAS1570   161
      NT = NIN                                                       QUAS1580
      NIN = NOUT                                                     QUAS1590
      NOUT = NT                                                      QUAS1600
C                                                                    QUAS1610
C - - RE-CALCULATE ROW LENGTH AND LOOP BACK                          QUAS1620
C                                                                    QUAS1630
      NEL = NEL - K                                                  QUAS1640
      NN = NEL - K                                                   QUAS1650
```

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      QUAS        - EFN   SOURCE STATEMENT  -  IFN(S)  -                01/15/71

      GO TO 10                                                       QUAS1660
C                                                                    QUAS1670
C - - REWIND ALL TAPES                                               QUAS1680
C                                                                    QUAS1690
   90 REWIND NIN                                                     QUAS1700   167
      REWIND NOUT                                                    QUAS1710
C                                                                    QUAS1720   168
  105 N1 = KORE - K * M + 1                                          QUAS1730
      REWIND LTAPE                                                   QUAS1740   170
      READ  (LTAPE)   NTPI                                           QUAS1750   171
      REWIND NT                                                      QUAS1760
C*** ***CALCULATE THE NUMBER OF COLUMNS TO BRING OFF OF THE RHS TAPE QUAS1770   173
      NTOTAL = 0                                                     QUAS1780
      M = MMAX                                                       QUAS1790
      IF(M .EQ. 0)GO TO 295                                          QUAS1800
C*** ***NTOTAL IS THE TOTAL NUMBER OF RHS COLUMNS ALREADY BROUGHT IN QUAS1810
  109 NTOTAL = NTOTAL + M                                            QUAS1820
      LASTRS = NTOTAL.GE. MRHS                                       QUAS1830
      NTOTAL = NTOTAL - M                                            QUAS1840
      IF (LASTRS)M = MRHS - NTOTAL                                   QUAS1850
      NTOTAL = NTOTAL + M                                            QUAS1860
C*** ***BRING IN M COLUMNS OF RHS                                    QUAS1870
      KINIT = KORE - (M*N)                                           QUAS1880
      IINIT = KINIT                                                  QUAS1890
      NBEG = KINIT + 1                                               QUAS1900
      NEND = KINIT+ N                                                QUAS1910
      DO 110 J =1,M                                                  QUAS1920
      READ (RHSTAP)( A(I),I=NBEG,NEND)                               QUAS1930   193
      NBEG = NEND + 1                                                QUAS1940
  110 NEND = NEND + N                                                QUAS1950
C*** ***BRING IN L(I,J) MATRIX AND APPLY IT TO RHS                   QUAS1960
      NGEG = 1 + KINIT                                               QUAS1970
      NEND = 1 + (M-1) * N + KINIT                                   QUAS1980
      KSUM = 0                                                       QUAS1990
C*** ***DO TRIANGULAR SECTION OF LMATRIX                             QUAS2000
      NLCNT = 0                                                      QUAS2010
  111 READ (LTAPE)K                                                  QUAS2020   205
      NLCNT = NLCNT + 1                                              QUAS2030
C*** ***KSUM IS THE TOTAL NUMBER OF L ROWS THAT WILL                 QUAS2040
C*** ***BE READ AFTER THIS TRIANGULAR SECTION IS FINISHED            QUAS2050
      KSUM = KSUM + K                                                QUAS2060
      KM1 = K - 1                                                    QUAS2070
C***   ***NOTE THAT KM1 CAN'T BE 0 SINCE K CAN'T BE 1 AND STILL HAVE SOMQUAS2080
C***   ***ON THE LTAPE                                               QUAS2090
      DO 114  I = 1,KM1                                              QUAS2100
      NBEG = NBEG + 1                                                QUAS2110
      NEND = NEND + 1                                                QUAS2120
C*** ***READ 1 ROW OF L(I,J) FROM LTAPE---K-1 TIMES---EACH TIME      QUAS2130
C*** ***STARTING WITH L(I)                                           QUAS2140
 1114 CONTINUE                                                       QUAS2150
      READ (LTAPE) ( A(NN),NN=1,I)                                   QUAS2160   214
      JCNT = -1                                                      QUAS2170
C*** ***REDUCE THE RHS BY GOING ACROSS A SOLUTION ROW (WHICH         QUAS2180
C*** ***ARE NOT IN CONSECUTIVE ORDER, BUT A(1), A(N+1), A(2N+1) ETC.) QUAS2190
      DO 113 NPP = NBEG,NEND,N                                       QUAS2200
      JCNT = JCNT + 1                                                QUAS2210
```

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      QUAS         -  EFN   SOURCE STATEMENT  -  IFN(S)  -                01/15/71

      SUM = (0.0,0.0)                                                      QUAS2220
      NROW = KINIT + ( JCNT * N )                                          QUAS2230
      DO 112 MM=1,K                                                        QUAS2240
      NROW = NROW + 1                                                      QUAS2250
  112 SUM = SUM + ( A(MM,J)*A(NROW))                                       QUAS2260
  113 A(NPP) = A(NPP) - SUM                                                QUAS2270
  114 CONTINUE                                                             QUAS2280
      IF (KSUM .EQ. N)GO TO 116                                            QUAS2290
C*** ***KSUM = N IF YOU HAVE READ ENTIRE LMATRIX AND                        QUAS2300
C*** ***THERE IS NO CONSTANT SECTION LEFT                                   QUAS2310
      NTBEG = NBEG                                                         QUAS2320
      NTEND = NEND                                                         QUAS2330
      KSUMP1 = KSUM + 1                                                    QUAS2340
C*** ***READ REST OF LROWS 1 ROW AT A TIME FOR CONSTANT SECTION             QUAS2350
      DO 115 I=KSUMP1,N                                                    QUAS2360
      NTBEG = NTBEG + 1                                                    QUAS2370
      NTEND = NTEND + 1                                                    QUAS2380
 1115 CONTINUE                                                             QUAS2390
      READ (LTAPE)( A(MM),MM=1,K)                                          QUAS2400     247
      JCNT = -1                                                            QUAS2410
C*** ***PARTIALLY  REDUCE A RHS ACROSS A RHS ROW BY APPLYING K NUMBER       QUAS2420
C*** ***OF L(I,J) S                                                         QUAS2430
      DO 124 NPP = NTBEG,NTEND,N                                           QUAS2440
      JCNT = JCNT + 1                                                      QUAS2450
      SUM = (0.0,0.0)                                                      QUAS2460
      NROW = KINIT + ( JCNT * N )                                          QUAS2470
      DO 123 MM = 1,K                                                      QUAS2480
      NROW = NROW + 1                                                      QUAS2490
  123 SUM = SUM + ( A(MM) * A(NROW) )                                      QUAS2500
  124 A(NPP) = A(NPP) - SUM                                                QUAS2510
  115 CONTINUE                                                             QUAS2520
      NBEG = NBEG + 1                                                      QUAS2530
      NEND = NEND + 1                                                      QUAS2540
C*** ***KINIT IS HOW FAR DOWN A COLUMN OF RHS TO START MULTIPLYING BY       QUAS2550
C*** ***L(I,J) AT EACH PASS THROUGH                                         QUAS2560
      KINIT = KINIT + K                                                    QUAS2570
C*** ***IF KSUMP1 = N THERE ARE NO MORE L(I,J)'S LEFT                       QUAS2580
      IF(KSUMP1 .LT. N)GO TO 111                                           QUAS2590
C*** ***WRITE OUT ALL BUT LAST K ROWS OF RHS IN ROW ORDER ON NATAPE         QUAS2600
  116 B = APM + 3                                                          QUAS2610
      C = -2 * KORE                                                        QUAS2620
      K = (  -B  +  SQRT( B**2  -4.0*C )  )/2.0                            QUAS2630     277
      IF(K .GT. NO) K = NO                                                 QUAS2640
      KF = K                                                               QUAS2650
      KM1 = K - 1                                                          QUAS2660
      KLEFT = N - KF + IINIT                                               QUAS2670
      INITP1 = IINIT + 1                                                   QUAS2680
      NEND = (N-1)*N + IINIT                                               QUAS2690
      DO 117 NPP = INITP1,KLEFT                                            QUAS2700
      NEND = NEND + 1                                                      QUAS2710
  117 WRITE(NATAPE) ( A(J),J=NPP,NEND,N)                                   QUAS2720     289
      REWIND NATAPE                                                        QUAS2730
C*** ***JPASS1 IS TRUE ON 1ST PASS THRU BACK SOLUTION                       QUAS2740     295
      JPASS1 = .TRUE.                                                      QUAS2750
C                                                                          QUAS2760
C***   ***PUT REMAINING RHS IN CONTIGUOUS LOCATIONS BY COLUMNS             QUAS2770
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      QUAS         -  EFN   SOURCE STATEMENT  -  IFN(S)  -                01/15/71

C***  FROM KORE - (M * KF) + 1  TO  KORE                                    QUAS2780
C                                                                          QUAS2790
      NNEW = KORE - KF + 1                                                 QUAS2800
      MM1 = M - 1                                                          QUAS2810
C                                                                          QUAS2820
C***   ***IF M = 1, THE ELTS OF THE 1 RHS COLUMN ARE ALREADY IN CONTIGUOUQUAS2830
C***   ***LOCATIONS                                                        QUAS2840
C                                                                          QUAS2850
      IF (M.EQ.1)  GO TO 1118                                              QUAS2860
      DO 118 I = 1,MM1                                                     QUAS2870
      NOLD = KORE - (I*N) + 1                                              QUAS2880
      DO 118 J = 1,KF                                                      QUAS2890
      NNEW = NNEW - 1                                                      QUAS2900
      NOLD = NOLD - 1                                                      QUAS2910
      A(NNEW) = A(NOLD)                                                    QUAS2920
  118 CONTINUE                                                             QUAS2930
 1118 CONTINUE                                                             QUAS2940
C                                                                          QUAS2950
C***   ***NOW NNEW = KORE - (M*KF) + 1                                     QUAS2960
C***   ***NOW NOLD = KORE - (M - 1) * N + 1 - KF                           QUAS2970
C   ***     SKIP 1ST PART OF TRAPEZOIDAL MATRIX + READ LAST K ROWS         QUAS2980
C*** ***ATTATCH RHS TO IT SO THAT EVERYTHING IS IN CONSECUTIVE ORDER        QUAS2990
      NREMAN = NO - K                                                      QUAS3000
      IF(NREMAN .EQ. 0)GO TO 126                                           QUAS3010
      DO 122 I = 1,NREMAN                                                  QUAS3020
  122 READ(MT) IDUMMY                                                      QUAS3030     323
  126 NEND = 0                                                             QUAS3040
      KCNT = K                                                             QUAS3050
      NNEW = NNEW - 1                                                      QUAS3060
C***   ***NOTE THAT K = ...  WHICH IS ALREADY KNOWN IN CORE                QUAS3070
      DO 121 JCNT = 1,...                                                  QUAS3080
      NBEG = NEND + 1                                                      QUAS3090
      KCNT = KCNT - 1                                                      QUAS3100
      NEND = NBEG + KCNT                                                   QUAS3110
      READ(MT)IDUMMY,(A(J),J=NBEG,NEND)                                    QUAS3120     336
      NNEW = NNEW + 1                                                      QUAS3130
      KEND = (MM1 * KF) + NNEW                                             QUAS3140
      DO 121 NPP=NNEW,KEND,KF                                              QUAS3150
      NEND = NEND + 1                                                      QUAS3160
  121 A(NEND) = A(NPP)                                                     QUAS3170
      REWIND LTAPE                                                         QUAS3180     350
      READ  (LTAPE)   NTPI                                                 QUAS3190     352
      REWIND MT                                                            QUAS3200
C                                                                          QUAS3210
C - - THERE, NOW WE CAN START THE BACK-SOLUTION                             QUAS3220
C * * NOTE..THE FIRST AVAILABLE LOCATION FOR THE SOLUTIONS IS A(N1)         QUAS3230
C                                                                          QUAS3240
C                                                                          QUAS3250
C***   ***NL IS THE LAST SUBSCRIPT + 1 OF THE TRAPEZOIDAL A MATRIX THAT QUAS3260
C***   ***CORE                                                             QUAS3270
C                                                                          QUAS3280     354
      NL = NEND + 1                                                        QUAS3290
      NREM = N                                                             QUAS3300
      NPM = N + M                                                          QUAS3310
      NEL = NPM                                                            QUAS3320
      MP1 = M + 1                                                          QUAS3330
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      GUAS          - EFN   SOURCE STATEMENT  -  (FN(S)                01/15/71

      LAST = K .EQ. N                                                   QUAS3340
      NPASS = 0                                                         QUAS3350
C                                                                       QUAS3360
C - - SOLVE FOR THE ANSWERS CORRESPONDING TO 'K' ROWS                    QUAS3370
C                                                                       QUAS3380
  119 KM1 = K - 1                                                       QUAS3390
      KP1 = K + 1                                                       QUAS3400
      NS = NL - MP1                                                     QUAS3410
      NPASS = NPASS + 1                                                 QUAS3420
      DO 130 MN = 1, M                                                  QUAS3430
      NF = NS + MN                                                      QUAS3440
      A(NF) = A(NF) / A(NS)                                             QUAS3450
      NT = NS                                                           QUAS3460
      IF (KM1 .EQ. 0) GO  TO 130                                        QUAS3470
      DO 125 IB = 1, KM1                                                QUAS3480
      NF = NF - IB - M                                                  QUAS3490
      NT = NT - MP1 - IB                                                QUAS3500
      SUM = (0.0,0.0)                                                   QUAS3510
      NP = NF                                                           QUAS3520
      N2 = MP1 + IB                                                     QUAS3530
      DO 120 IO = 1, IB                                                 QUAS3540
      NN = NT + IO                                                      QUAS3550
      NP = NP + N2 - IO                                                 QUAS3560
  120 SUM = SUM + A(NN) * A(NP)                                         QUAS3570
  125 A(NF) = (A(NF) - SUM) / A(NT)                                     QUAS3580
  130 CONTINUE                                                          QUAS3590
C                                                                       QUAS3600
C - - MOVE THE SOLUTIONS TO CONTIGUOUS LOCATIONS STARTING AT A(N1)      QUAS3610
C                                                                       QUAS3620
      N1 = KORE + 1                                                     QUAS3630
      DO 140 NN = 1, K                                                  QUAS3640
      DO 135 MN = 1, M                                                  QUAS3650
      NL = NL - 1                                                       QUAS3660
      N1 = N1 - 1                                                       QUAS3670
  135 A(N1) = A(NL)                                                     QUAS3680
  140 NL = NL - NN                                                      QUAS3690
C                                                                       QUAS3700
C - - WRITE THE SOLUTIONS ON TAPE                                       QUAS3710
C                                                                       QUAS3720
      WRITE (NIN) K                                                     QUAS3730     411
      NS = N1 - 1                                                       QUAS3740
      DO 145 MN = 1, M                                                  QUAS3750
      NT = NS + MN                                                      QUAS3760
  145 WRITE ( NIN ) (A(IO), IO = NT, KORE, M)                           QUAS3770
C                                                                       QUAS3780
C - - TEST IF THIS IS THE LAST PASS                                     QUAS3790
C                                                                       QUAS3800     418
      IF (LAST) GO TO 200                                               QUAS3810
C                                                                       QUAS3820
C - - WE MUST NOW MODIFY THE TRIANGULAR MATRIX TO REFLECT THE EFFECT OF QUAS3830
C     THE SOLUTIONS OBTAINED SO FAR  (EQ 21)                            QUAS3840
C * * NOTE..LOCATIONS A(1) TO A(N1 1) ARE NOW FREE TO USE               QUAS3850
C                                                                       QUAS3860
C - - CALCULATE THE NEXT VALUES OF 'NEL' AND 'NREM'                     QUAS3870
C                                                                       QUAS3880
      NELOLD = NEL                                                      QUAS3890
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      QUAS          - EFN   SOURCE STATEMENT  -  (FN(S)  -             01/15/71

      KOLD = K                                                          QUAS3900
      NEL = NEL - K                                                     QUAS3910
      NREM = NREM - K                                                   QUAS3920
C                                                                       QUAS3930
      NROW = NREM - K + 1                                               QUAS3940
      IF (K .LT. NREM) GO TO 150                                        QUAS3950
      LAST = .TRUE.                                                     QUAS3960
      NROW = 1                                                          QUAS3970
      K = NREM                                                          QUAS3980
  150 NS = 1                                                            QUAS3990
      NT = NELOLD + 1                                                   QUAS4000
C                                                                       QUAS4010
C - - READ IN THE ROWS TO BE MODIFIED                                   QUAS4020
C                                                                       QUAS4030
      DO 190 IB = 1, NREM                                               QUAS4040
      NT = NT - 1                                                       QUAS4050
      IF (IB .LE. NROW) GO TO 160                                       QUAS4060
      NS = NS + NN                                                      QUAS4070
      NT = NT + NN                                                      QUAS4080
  160 IF (.NOT. JPASS1)GO TO 161                                        QUAS4090
      NBEG = NT - M + 1                                                 QUAS4100
C*** ***READ RHS FROM NATAPE                                            QUAS4110
      READ (NATAPE) ( A(IO),IO = NBEG,NT)                               QUAS4120     491
      NT = NT - M                                                       QUAS4130
  161 READ(NT)NN,(A(IO),IO=NS,NT)                                       QUAS4140     456
      IF( .NOT. JPASS1 ) GO TO 162                                      QUAS4150
      NT = NT + M                                                       QUAS4160
      NN = NN + M                                                       QUAS4170
  162 NP = NL - 1                                                       QUAS4180
      NF = NT - M - KM1                                                 QUAS4190
      NN = NN - KOLD                                                    QUAS4200
      DO 170 MM = 1, M                                                  QUAS4210
      N2 = NF                                                           QUAS4220
      NA = NP + MM                                                      QUAS4230
      NB = NA                                                           QUAS4240
      SUM = (0.0,0.0)                                                   QUAS4250
      DO 165 IO = 1, KOLD                                               QUAS4260
      SUM = SUM + A(N2) * A(NA)                                         QUAS4270
      N2 = N2 + 1                                                       QUAS4280
  165 NA = NA + M                                                       QUAS4290
      N2 = N2 + NN - 1                                                  QUAS4300
  170 A(N2) = A(N2) - SUM                                               QUAS4310
C                                                                       QUAS4320
C - - WRITE THE MODIFIED ROW ON TAPE OR CONDENSE THE ROW                QUAS4330
C                                                                       QUAS4340
      NL = NT - N + 1                                                   QUAS4350
      IF (IB .GE. NROW) GO TO 175                                       QUAS4360
      NF = NL - KP1                                                     QUAS4370
      WRITE (NOUT) NN, (A(IO), IO = NS, NF), (A(IG), IO = NL, NT)       QUAS4380     490
      GO TO 190                                                         QUAS4390
  175 NF = NL - KOLD                                                    QUAS4400
      DO 180 MN = NL, NT                                                QUAS4410
      A(NF) = A(MN)                                                     QUAS4420
  180 NF = NF + 1                                                       QUAS4430
  190 CONTINUE                                                          QUAS4440
C*** ***IF 1ST TIME THRU BACK SOLN,SWITCH TAPES SO THAT NT WHICH HAS THEQUAS4450
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          QUAS          -  EFN    SOURCE STATEMENT  -  IFN(S)                01/15/71

C*** ***ORIGINAL TRAPEZOIDAL MATRIX ON IT BECOME NATAPE AND IS NOT TO    QUAS4460
C*** ***TAPE PART IN ALTERNATING SHRINKING MATRICES.  NATAPE BECOMES NT  QUAS4470
C*** ***AND THIS NOW DOES THE ALTERNATING WITH NOUT.                     QUAS4480
      IF( .NOT. JPASS1 ) GO TO 195                                       QUAS4490
      NTEMP = NT                                                         QUAS4500
      NT = NATAPE                                                        QUAS4510
      NATAPE = NTEMP                                                     QUAS4520
      JPASS1= .FALSE.                                                    QUAS4530
      REWIND NATAPE                                                      QUAS4540    518
  195 REWIND NT                                                          QUAS4550    519
      REWIND NOUT                                                        QUAS4560
C                                                                        QUAS4570
C - - SWITCH THE TAPES                                                   QUAS4580
C                                                                        QUAS4590    520
      NT = NT                                                            QUAS4600
      NT = NOUT                                                          QUAS4610
      NOUT = NT                                                          QUAS4620
C                                                                        QUAS4630
C - - LOOP BACK THRU THE SOLUTION                                        QUAS4640
C                                                                        QUAS4650
      NL = NF                                                            QUAS4660
      GO TO 119                                                          QUAS4670
C                                                                        QUAS4680
C - - START TO WRAP IT UP                                                QUAS4690
C                                                                        QUAS4700
  200 REWIND NIN                                                         QUAS4710    525
      N2 = N                                                             QUAS4720
C                                                                        QUAS4730
C * * NOTE.. AT THIS POINT ALL LOCATIONS A(1) THRU A(KORE) ARE FREE      QUAS4740
C                                                                        QUAS4750
      DO 220 I0 = 1, NPASS                                               QUAS4760
      READ (NIN) K                                                       QUAS4770    529
      N1 = N2 - K + 1                                                    QUAS4780
      NS = N1                                                            QUAS4790
      NT = N2                                                            QUAS4800
C                                                                        QUAS4810
C - - READ IN THE SOLUTIONS                                              QUAS4820
C                                                                        QUAS4830
      DO 210 IO = 1, N                                                   QUAS4840
      READ (NIN) (A(NN), NN = NS, NT)                                    QUAS4850    535
      NT = NT + N                                                        QUAS4860
  210 NS = NS + N                                                        QUAS4870
  220 N2 = N1 - 1                                                        QUAS4880
C                                                                        QUAS4890
C  ---  REWIND ALL INPUT TAPES                                           QUAS4900
      REWIND NIN                                                         QUAS4910    546
      REWIND NT                                                          QUAS4920    547
      REWIND NOUT                                                        QUAS4930
C - - WRITE THE SOLUTIONS ON TAPE                                        QUAS4940
C                                                                        QUAS4950    548
      NT = 0                                                             QUAS4960
      DO 230 IO = 1, N                                                   QUAS4970
      NS = NT + 1                                                        QUAS4980
      NT = NT + N                                                        QUAS4990
      IF (NPR1.EQ.0) GO TO 230                                           QUAS4992
      WRITE (6,3) IO                                                     QUAS4994    557
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          QUAS          -  EFN    SOURCE STATEMENT  -  IFN(S)  -               01/15/71

      WRITE (6,2) (A(NN), NN = NS, NT)                                   QUAS4996    558
  230 WRITE (NW) (A(NN), NN = NS, NT)                                    QUAS5000
C   ***   IF TAPE WAS NEVER SWITCHED IT WOULD BE FOOLISH TO SWITCH BACK QUAS5010    563
      IF(JPASS1)GO TO 290                                                QUAS5020
C                                                                        QUAS5030
C***   ***SWITCH TAPES                                                   QUAS5040
C*** ***BACK SO THAT  NT WILL CONAIN THE TRAPEZOIDAL MATRIX               QUAS5050
C*** ***NATAPE WILL HAVE NOTHING USEFUL ON IT.                            QUAS5060
      NTEMP = NATAPE                                                     QUAS5070
      NATAPE = NT                                                        QUAS5080
      NT = NTEMP                                                         QUAS5090
      REWIND NATAPE                                                      QUAS5100    575
  290 IF( .NOT. LASTRS)GO TO 109                                         QUAS5110
  295 REWIND LTAPE                                                       QUAS5120    579
      READ  (LTAPE)   NTP1                                               QUAS5130    580
      REWIND NT                                                          QUAS5140    582
      KRED = 0                                                           QUAS5150
      DO 297 I=1,NLCNT                                                   QUAS5160
      READ(LTAPE)KREAD                                                   QUAS5170    586
  304 CONTINUE                                                           QUAS5180
      KRED = KRED + KREAD                                                QUAS5190
      KREAD = KREAD + ( N - KRED - 1)                                    QUAS5200
      DO 297 LREAD=1,KREAD                                               QUAS5210
  297 READ(LTAPE)                                                        QUAS5220    593
      DO 299 NROW = 1,ND                                                 QUAS5230
      READ(NT) ICNT,(A(I),I=1,ICNT)                                      QUAS5240    599
  299 WRITE(LTAPE)ICNT,(A(I),I=1,ICNT)                                   QUAS5250
C                                                                        QUAS5260
C   ***   REWIND ALL FILES EXCEPT THE OUTPUT FILE   NW                   QUAS5270
C                                                                        QUAS5280    605
      REWIND LTAPE                                                       QUAS5290    611
      REWIND NI                                                          QUAS5300    612
      REWIND NN                                                          QUAS5310    613
      REWIND ND                                                          QUAS5320    614
      REWIND NAT                                                         QUAS5330    615
      IF( RHSTAP .NE. 0 ) REWIND RHSTAP                                  QUAS5340    616
      ND = NTOTAL                                                        QUAS5350
 9999 CONTINUE                                                           QUAS5360
      RETURN                                                             QUAS5370
      END                                                                QUAS5380
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FUTSOL      - EFN   SOURCE STATEMENT  -  IFN(S)  -                  01/15/71

      SUBROUTINE FUT2OL(NO,MD,KD,NI,NN,NC,NAT,NW,LTAPE,RHSTAP,NPRI)      FUTS0005
C                                                                      FUTS0010
C  ***   THIS IS THE COMPLEX VERSION OF FUTSOL                         FUTS0015
C                                                                      FUTS0020
C                                                                      FUTS0025
C                                                                      FUTS0030
C          ****   ***/  *******  *****  *       ***/        *          FUTS0035
C          *   *  *  /*    *     *      *       *  /*     ******       FUTS0040
C    ****  ****   * / *    *     ***    *       * / *  ****  *  *      FUTS0045
C          *      */  *    *     *      *       */  *        ***       FUTS0050
C          *      /***     *     *      *****   /***         *  *      FUTS0055
C                                                                      FUTS0060
C               D I R E C T   M A T R I X   S O L U T I O N            FUTS0065
C                                                                      FUTS0070
C     WRITTEN BY J. L. HESS * PROGRAMMED BY C. D. SCHOOR               FUTS0075
C*** ***LTAPE IS THE TAPE THE L(I,J) MATRIX WILL BE PUT ON             FUTS0080
C*** ***RHSTAP IS THE TAPE THAT THE RIGHT HAND SIDES ARE INPUT ON      FUTS0085
      INTEGER RHSTAP                                                   FUTS0090
C                                                                      FUTS0095
      COMPLEX  A(37C0), SUM                                            FUTS0100
C                                                                      FUTS0105
      LOGICAL JPASS1                                                   FUTS0110
      LOGICAL  LASTRS                                                  FUTS0115
      LOGICAL  LAST                                                    FUTS0120
C                                                                      FUTS0125
    2 FORMAT (1H0,6E20.8)                                              FUTS0124
    3 FORMAT (1H0, 10HCOLUMN NO.,I6,2X,17HOF GAMMAS FOLLOWS,//)        FUTS0128
    1 CONTINUE                                                         FUTS0130
      REWIND LTAPE                                                     FUTS0135    1
      READ  (LTAPE)   NTPI                                             FUTS0140    2
      NATAPE = NAT                                                     FUTS0145
      REWIND NATAPE                                                    FUTS0150    4
      REWIND NW                                                        FUTS0155    5
      N = NO                                                           FUTS0160
      KORE = KD                                                        FUTS0165
C*** *  RHSTAP = 0 IF THERE ARE NO RHS TO BE PROCESSED THIS RUN        FUTS0170
      IF(RHSTAP .NE. 0 )GO TO 5                                        FUTS0175
      MRHS = 0                                                         FUTS0180
      GO TO 6                                                          FUTS0185
    5 REWIND RHSTAP                                                    FUTS0190   12
      READ(RHSTAP)MRHS                                                 FUTS0195   13
    6 M = KORE/N -1                                                    FUTS0200
      MMAX = MIN0(MRHS,M)                                              FUTS0205
      NPM = N + MMAX                                                   FUTS0210
      IF (MAX0(3 * NPM, N * N) .GT. KORE) RETURN                       FUTS0215
      M = 0                                                            FUTS0220
      NPM = N                                                          FUTS0225
      NT = NN                                                          FUTS0230
      REWIND NT                                                        FUTS0235   23
      NIN = NI                                                         FUTS0240
      REWIND NIN                                                       FUTS0245   24
      NOUT = NO                                                        FUTS0250
      REWIND NOUT                                                      FUTS0255   25
      NR = N                                                           FUTS0260
      NEL = NPM                                                        FUTS0265
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FUTSOL      - EFN   SOURCE STATEMENT  -  IFN(S)  -                  01/15/71

C                                                                      FUTS0270
C - - CALCULATE THE MAXIMUM NO. OF ROWS, "K"                           FUTS0275
C                                                                      FUTS0280
C*** ***CALCULATE THE NUMBER OF COLUMNS TO BRING OFF OF THE RHS TAPE   FUTS0285
      MTOTAL = 0                                                       FUTS0290
      M = MMAX                                                         FUTS0295
      IF(M .EQ. 0)GO TO 295                                            FUTS0300
C*** ***MTOTAL IS THE TOTAL NUMBER OF RHS COLUMNS ALREADY BROUGHT IN   FUTS0305
  109 MTOTAL = MTOTAL + M                                              FUTS0310
      LASTRS = MTOTAL.GE. MRHS                                         FUTS0315
      MTOTAL = MTOTAL - M                                              FUTS0320
      IF (LASTRS)M = MRHS - MTOTAL                                     FUTS0325
      MP1 = M + 1                                                      FUTS0330
      MM1 = M - 1                                                      FUTS0335
      MTOTAL = MTOTAL + M                                              FUTS0340
C*** ***BRING IN M COLUMNS OF RHS                                      FUTS0345
      KINIT = KORE - (M*N)                                             FUTS0350
      IINIT = KINIT                                                    FUTS0355
      NBEG = KINIT + 1                                                 FUTS0360
      NEND = KINIT+ N                                                  FUTS0365
      DO 110 J =1,M                                                    FUTS0370
      READ (RHSTAP)( A(I),I=NBEG,NEND)                                 FUTS0375   49
      NBEG = NEND + 1                                                  FUTS0380
  110 NEND = NEND + N                                                  FUTS0385
C*** ***BRING IN L(I,J) MATRIX AND APPLY IT TO RHS                     FUTS0390
      NBEG = 1 + KINIT                                                 FUTS0395
      NEND = 1 + (M-1) * N + KINIT                                     FUTS0400
      KSUM = 0                                                         FUTS0405
      NLCNT = 0                                                        FUTS0410
C*** ***DO TRIANGULAR SECTION OF LMATRIX                               FUTS0415
  111 READ (LTAPE)K                                                    FUTS0420   61
      NLCNT = NLCNT + 1                                                FUTS0425
C*** ***KSUM IS THE TOTAL NUMBER OF L ROWS THAT WILL                   FUTS0430
C*** ***BE READ AF..R THIS TRIANGULAR SECTION IS FINISHED              FUTS0435
      KSUM = KSUM + K                                                  FUTS0440
      KM1 = K - 1                                                      FUTS0445
C***   ***NOTE THAT KM1 CAN'T BE 0 SINCE K CAN'T BE 1 AND STILL HAVE SOMFUTS0450
C***   ***ON THE LTAPE                                                 FUTS0455
      DO 114  I = 1,KM1                                                FUTS0460
      NBEG = NBEG + 1                                                  FUTS0465
      NEND = NEND + 1                                                  FUTS0470
C*** ***READ 1 ROW OF L(I,J) FROM LTAPE---K-1 TIMES---EACH TIME        FUTS0475
C*** ***STARTING WITH L(1)                                             FUTS0480
      READ (LTAPE) ( A(NN),NN=1,I)                                     FUTS0485   70
      JCNT = -1                                                        FUTS0490
C*** ***REDUCE THE RHS BY GOING ACROSS A SOLUTION ROW (WHICH           FUTS0495
C*** ***ARE NOT IN CONSECUTIVE ORDER, BUT A(I)', A(N+I), A(2N+I) ETC.) FUTS0500
      DO 113 NPP = NBEG,NEND,N                                         FUTS0505
      JCNT = JCNT + 1                                                  FUTS0510
      SUM = (0.0,0.0)                                                  FUTS0515
      NROW = KINIT + ( JCNT * N )                                      FUTS0520
      DO 112 NN=1,I                                                    FUTS0525
      NROW = NROW + 1                                                  FUTS0530
  112 SUM = SUM + ( A(NN)*A(NROW))                                     FUTS0535
  113 A(NPP) = A(NPP) - SUM                                            FUTS0540
  114 CONTINUE                                                         FUTS0545
```

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                                                                01/15/71
        FUTSOL      - EFN   SOURCE STATEMENT  -  IFN(S)  -

      IF (KSUM .EQ. N)GO TO 116                                  FUTS0550
C*** ***KSUM = N IF YOU HAVE READ ENTIRE LMATRIX AND              FUTS0555
C*** ***THERE IS NO CONSTANT SECTION LEFT                         FUTS0560
      NTBEG = NBEG                                               FUTS0565
      NTEND = NEND                                               FUTS0570
      KSUMP1 = KSUM + 1                                          FUTS0575
C*** ***READ REST OF LROWS 1 ROW AT A TIME FOR CONSTANT SECTION   FUTS0580
      DO 115 I=KSUMP1,N                                          FUTS0585
      NTBEG = NTBEG + 1                                          FUTS0590
      NTEND = NTEND + 1                                          FUTS0595
      READ (LTAPE)( A(NN),NN=1,K)                                FUTS0600    103
      JCNT = -1                                                  FUTS0605
C*** ***PARTIALLY  REDUCE A RHS ACROSS A RHS ROW BY APPLYING K NUMBER  FUTS0610
C*** ***OF L(I,J) S                                              FUTS0615
      DO 124 NPP = NTBEG,NTEND,N                                 FUTS0620
      JCNT = JCNT + 1                                            FUTS0625
      SUM = (0.0,0.0)                                            FUTS0630
      NROW = KINIT + ( JCNT * N )                                FUTS0635
      DO 123 NN = 1,K                                            FUTS0640
      NROW = NROW + 1                                            FUTS0645
  123 SUM = SUM + ( A(NN) * A(NROW) )                            FUTS0650
  124 A(NPP) = A(NPP) - SUM                                      FUTS0655
  115 CONTINUE                                                   FUTS0660
      NBEG = NBEG + 1                                            FUTS0665
      NEND = NEND + 1                                            FUTS0670
C*** ***KINIT IS NOW FAR DOWN A COLUMN OF RHS TO START MULTIPLYING BY  FUTS0675
C*** ***L(I,J) AT EACH PASS THROUGH                               FUTS0680
      KINIT = KINIT + K                                          FUTS0685
C*** ***IF KSUMP1 = N THERE ARE NO MORE L(I,J)'S LEFT             FUTS0690
      IF(KSUMP1 .LT. N)GO TO 111                                 FUTS0695
C*** ***WRITE OUT ALL BUT LAST K ROWS OF RHS IN ROW ORDER ON NATAPE  FUTS0700
  116 B = 4*M + 3                                                FUTS0705
      C = -2 * KORE                                              FUTS0710
      K = ( -B  +  SQRT( B**2  -4.0*C )  )/2.0                   FUTS0715    133
      IF(K .GT. NO) K = NO                                       FUTS0720
      KF = K                                                     FUTS0725
      KM1 = K - 1                                                FUTS0730
      KLEFT = N - KF + IINIT                                     FUTS0735
      INITP1 = IINIT + 1                                         FUTS0740
      NEND = (M-1)*N + IINIT                                     FUTS0745
      DO 117 NPP = INITP1,KLEFT                                  FUTS0750
      NEND = NEND + 1                                            FUTS0755
  117 WRITE(NATAPE) ( A(J),J=NPP,NEND,N)                         FUTS0760    145
      REWIND NATAPE                                              FUTS0765
C*** ***JPASS1 IS TRUE ON 1ST PASS THRU BACK SOLUTION             FUTS0770    151
      JPASS1 = .TRUE.                                            FUTS0775
C                                                                FUTS0780
C***   ***PUT REMAINING RHS IN CONTIGUOUS LOCATIONS BY COLUMNS    FUTS0785
C***   FROM KORE - (M * KF) + 1  TO  KORE                        FUTS0790
C                                                                FUTS0795
      NNEW = KORE - KF + 1                                       FUTS0800
C                                                                FUTS0805
C***   ***IF M = 1, THE ELTS OF THE 1 RHS COLUMN ARE ALREADY IN CONTIGUOFUTS0810
C***   ***LOCATIONS                                              FUTS0815
C                                                                FUTS0820
      IF (M.EQ.1)  GO TO 1118                                    FUTS0825
```

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                                                                01/15/71
        FUTSOL      - EFN   SOURCE STATEMENT  -  IFN(S)  -

      DO 110 I = 1,MM1                                           FUTS0830
      NOLD = KORE - (I*N) + 1                                    FUTS0835
      DO 110 J = 1,KF                                            FUTS0840
      NNEW = NNEW - 1                                            FUTS0845
      NOLD = NOLD - 1                                            FUTS0850
      A(NNEW) = A(NOLD)                                          FUTS0855
  110 CONTINUE                                                   FUTS0860
 1118 CONTINUE                                                   FUTS0865
C                                                                FUTS0870
C***   ***NOW NNEW = KORE - (M*KF) + 1                           FUTS0875
C***   ***NOW NOLD = KORE - (M - 1) * N + 1 - KF                 FUTS0880
C  **   SKIP 1ST PART OF TRAPEZOIDAL MATRIX ON LTAPE             FUTS0885
C  **   READ IN LAST K ROWS OF TRAPEZOIDAL MATRIX AND            FUTS0890
C*** ***ATTATCH RHS TO IT SO THAT EVERYTHING IS IN CONSECUTIVE ORDER  FUTS0895
      NREMAN = NO - K                                            FUTS0900
      IF( NREMAN .EQ. 0 )GO TO 126                               FUTS0905
      DO 122 I=1,NREMAN                                          FUTS0910
  122 READ(LTAPE) IDUMMY                                         FUTS0915    178
  126 NEND = 0                                                   FUTS0920
      KCNT = K                                                   FUTS0925
      NNEW = NNEW - 1                                            FUTS0930
C***   ***NOTE THAT K = KF WHICH IS ALREADY KNOWN IN CORE        FUTS0935
      DO 121 JCNT = 1,K                                          FUTS0940
      NBEG = NEND + 1                                            FUTS0945
      KCNT = KCNT - 1                                            FUTS0950
      NEND = NBEG + KCNT                                         FUTS0955
      READ(LTAPE)IDUMMY,(A(J),J=NBEG,NEND)                       FUTS0960    191
      NNEW = NNEW + 1                                            FUTS0965
      KEND = (MM1 * KF) + NNEW                                   FUTS0970
      DO 121 NPP=NNEW,KEND,KF                                    FUTS0975
      NEND = NEND + 1                                            FUTS0980
  121 A(NEND) = A(NPP)                                           FUTS0985
      REWIND LTAPE                                               FUTS0990    206
      READ  (LTAPE)   NTPI                                       FUTS0995
C                                                                FUTS1000
C  **  SKIP OVER L MATRIX ON LTAPE TO GET TO TRAPEZOIDAL MATRIX   FUTS1005
C                                                                FUTS1010    207
      KRED = 0                                                   FUTS1015
      DO 128 I=1,NLCNT                                           FUTS1020
      READ(LTAPE)KREAD                                           FUTS1025    212
      KRED = KRED + KREAD                                        FUTS1030
      KREAD = KREAD + ( N - KRED - 1)                            FUTS1035
      DO 128 LREAD = 1,KREAD                                     FUTS1040
  128 READ(LTAPE)                                                FUTS1045
C                                                                FUTS1050
C - - THERE, NOW WE CAN START THE BACK-SOLUTION                   FUTS1055
C * * NOTE..THE FIRST AVAILABLE LOCATION FOR THE SOLUTIONS IS A(NL)  FUTS1060
C                                                                FUTS1065
C                                                                FUTS1070
C***   ***NL IS THE LAST SUBSCRIPT + 1 OF THE TRAPEZOIDAL A MATRIX THAT FUTS1075
C***   ***CORE                                                   FUTS1080
C                                                                FUTS1085    218
      NL = NEND + 1                                              FUTS1090
      NREM = N                                                   FUTS1095
      NPM = N + M                                                FUTS1100
      NEL = NPM                                                  FUTS1105
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          FUTSOL      -  EFN   SOURCE STATEMENT  -  IFN(S)  -              01/15/71

      MP1 = M + 1                                                          FUTS1110
      LAST = K .EQ. M                                                      FUTS1115
      NPASS = 0                                                            FUTS1120
C                                                                          FUTS1125
C - - SOLVE FOR THE ANSWERS CORRESPONDING TO 'K' ROWS                      FUTS1130
C                                                                          FUTS1135
  119 KM1 = K - 1                                                          FUTS1140
      KP1 = K + 1                                                          FUTS1145
      NS = ML - MP1                                                        FUTS1150
      NPASS = NPASS + 1                                                    FUTS1155
      DO 130 MM = 1, M                                                     FUTS1160
      NF = NS + MM                                                         FUTS1165
      A(NF) = A(NF) / A(NS)                                                FUTS1170
      NT = NS                                                              FUTS1175
      IF (KM1 .EQ. 0) GO  TO 130                                           FUTS1180
      DO 125 IB = 1, KM1                                                   FUTS1185
      NF = NF - IB - M                                                     FUTS1190
      NT = NT - MP1 - IB                                                   FUTS1195
      SUM = (0.0,0.0)                                                      FUTS1200
      NP = NF                                                              FUTS1205
      N2 = MP1 + IB                                                        FUTS1210
      DO 120 IO = 1, IB                                                    FUTS1215
      NN = NT + IO                                                         FUTS1220
      NP = NP + N2 - IO                                                    FUTS1225
  120 SUM = SUM + A(NN) * A(NP)                                            FUTS1230
  125 A(NF) = (A(NF) - SUM) / A(NT)                                        FUTS1235
  130 CONTINUE                                                             FUTS1240
C                                                                          FUTS1245
C - - MOVE THE SOLUTIONS TO CONTIGUOUS LOCATIONS STARTING AT A(N1)         FUTS1250
C                                                                          FUTS1255
      N1 = KORE + 1                                                        FUTS1260
      DO 140 MM = 1, K                                                     FUTS1265
      DO 135 MN = 1, M                                                     FUTS1270
      ML = ML - 1                                                          FUTS1275
      N1 = N1 - 1                                                          FUTS1280
  135 A(N1) = A(ML)                                                        FUTS1285
  140 ML = ML - MM                                                         FUTS1290
C                                                                          FUTS1295
C - - WRITE THE SOLUTIONS ON TAPE                                          FUTS1300
C                                                                          FUTS1305
      WRITE (NIN) K                                                        FUTS1310     280
      NS = N1 - 1                                                          FUTS1315
      DO 145 MN = 1, M                                                     FUTS1320
      NT = NS + MM                                                         FUTS1325
  145 WRITE ( NIN ) (A(IO), IO = NT, KORE, M)                              FUTS1330
C                                                                          FUTS1335
C - - TEST IF THIS IS THE LAST PASS                                        FUTS1340
C                                                                          FUTS1345     285
      IF (LAST) GO TO 200                                                  FUTS1350
C                                                                          FUTS1355
C - - WE MUST NOW MODIFY THE TRIANGULAR MATRIX TO REFLECT THE EFFECT OF    FUTS1360
C     THE SOLUTIONS OBTAINED SO FAR  (EQ 21)                               FUTS1365
C * * NOTE..LOCATIONS A(1) TO A(N1-1) ARE NOW FREE TO USE                  FUTS1370
C                                                                          FUTS1375
C - - CALCULATE THE NEXT VALUES OF 'NEL' AND 'NREM'                        FUTS1380
C                                                                          FUTS1385
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          FUTSOL      -  EFN   SOURCE STATEMENT  -  IFN(S)  -              01/15/71

      NELOLD = NEL                                                         FUTS1390
      KOLD = K                                                             FUTS1395
      NEL = NEL - K                                                        FUTS1400
      NREM = NREM - K                                                      FUTS1405
C                                                                          FUTS1410
      NROW = NREM - K + 1                                                  FUTS1415
      IF (K .LT. NREM) GO TO 150                                           FUTS1420
      LAST = .TRUE.                                                        FUTS1425
      NROW = 1                                                             FUTS1430
      K = NREM                                                             FUTS1435
  150 NS = 1                                                               FUTS1440
      NT = NELOLD + 1                                                      FUTS1445
C                                                                          FUTS1450
C - - READ IN THE ROWS TO BE MODIFIED                                      FUTS1455
C                                                                          FUTS1460
      DO 190 IB = 1, NREM                                                  FUTS1465
      NT = NT - 1                                                          FUTS1470
      IF (IB .LE. NROW) GO TO 160                                          FUTS1475
      NS = NS + NN                                                         FUTS1480
      NT = NT + NN                                                         FUTS1485
  160 IF (.NOT. JPASS1)GO TO 161                                           FUTS1490
      NBEG = NT - M + 1                                                    FUTS1495
C*** ***READ RHS FROM NATAPE                                               FUTS1500
      READ (NATAPE) ( A(IO),IO = NBEG,NT)                                  FUTS1505     318
      NT = NT - M                                                          FUTS1510
      READ(LTAPE)NN,(A(IO),IO=NS,NT)                                       FUTS1515     323
      NT = NT + M                                                          FUTS1520
      NN = NN + M                                                          FUTS1525
      GO TO 163                                                            FUTS1530
  161 READ(NT)NN,(A(IO),IO=NS,NT)                                          FUTS1535     331
  163 NP = N1 - 1                                                          FUTS1540
      NF = NT - M - KM1                                                    FUTS1545
      NN = NN - KOLD                                                       FUTS1550
      DO 170 MN = 1, M                                                     FUTS1555
      N2 = NF                                                              FUTS1560
      NA = NP + MN                                                         FUTS1565
      NB = NA                                                              FUTS1570
      SUM = (0.0,0.0)                                                      FUTS1575
      DO 165 IO = 1, KOLD                                                  FUTS1580
      SUM = SUM + A(N2) * A(NA)                                            FUTS1585
      N2 = N2 + 1                                                          FUTS1590
  165 NA = NA + M                                                          FUTS1595
      N2 = N2 + NN - 1                                                     FUTS1600
  170 A(N2) = A(N2) - SUM                                                  FUTS1605
C                                                                          FUTS1610
C - - WRITE THE MODIFIED ROW ON TAPE OR CONDENSE THE ROW                   FUTS1615
C                                                                          FUTS1620
      ML = NT - M + 1                                                      FUTS1625
      IF (IB .GE. NROW) GO TO 175                                          FUTS1630
      NF = ML - KP1                                                        FUTS1635
      WRITE (NOUT) NN, (A(IO), IO = NS, NF), (A(IO), IO = ML, NT)          FUTS1640     361
      GO TO 190                                                            FUTS1645
  175 NF = ML - KOLD                                                       FUTS1650
      DO 180 MN = ML, NT                                                   FUTS1655
      A(NF) = A(MN)                                                        FUTS1660
  180 NF = NF + 1                                                          FUTS1665
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      FUTSOL      - EFN   SOURCE STATEMENT  -  IFN(S)  -                          01/15/71

  199 CONTINUE                                                              FUTS1670
      IF( .NOT. JPASS1 ) GO TO 195                                          FUTS1675
      JPASS1= .FALSE.                                                       FUTS1680
      REWIND NATAPE                                                         FUTS1685    386
  195 REWIND NT                                                             FUTS1690    387
      REWIND NOUT                                                           FUTS1695
C                                                                           FUTS1700
C - - SWITCH THE TAPES                                                      FUTS1705
C                                                                           FUTS1710    388
      NC = NT                                                               FUTS1715
      NT = NOUT                                                             FUTS1720
      NOUT = NC                                                             FUTS1725
C                                                                           FUTS1730
C - - LOOP BACK THRU THE SOLUTION                                           FUTS1735
C                                                                           FUTS1740
      NL = NP                                                               FUTS1745
      GO TO 109                                                             FUTS1750
C                                                                           FUTS1755
C - - START TO WRAP IT UP                                                   FUTS1760
C                                                                           FUTS1765
  200 REWIND NIN                                                            FUTS1770    393
      NJ = N                                                                FUTS1775
C                                                                           FUTS1780
C * * NOTE.. AT THIS POINT ALL LOCATIONS A(1) THRU A(NORE) ARE FREE          FUTS1785
C                                                                           FUTS1790
      DO 220 IG = 1, NPASS                                                  FUTS1795
      READ (NOM) K                                                          FUTS1800    397
      NI = NJ - K + 1                                                       FUTS1805
      NS = NI                                                               FUTS1810
      NT = NJ                                                               FUTS1815
C                                                                           FUTS1820
C - - READ IN THE SOLUTIONS                                                 FUTS1825
C                                                                           FUTS1830
      DO 210 IO = 1, N                                                      FUTS1835
      READ (NIN) (A(NN), NN = NS, NT)                                       FUTS1840    403
      NT = NT + N                                                           FUTS1845
  210 NS = NS + N                                                           FUTS1850
  220 NJ = NI - 1                                                           FUTS1855
C                                                                           FUTS1860
C ----  REWIND ALL INPUT TAPES                                              FUTS1865
      REWIND NIN                                                            FUTS1870    414
      REWIND NT                                                             FUTS1875    415
      REWIND NOUT                                                           FUTS1880
C - - WRITE THE SOLUTIONS ON TAPE                                           FUTS1885
C                                                                           FUTS1890    416
      NT = 0                                                                FUTS1895
      DO 230 IO = 1, N                                                      FUTS1900
      NS = NT + 1                                                           FUTS1905
      NT = NT + N                                                           FUTS1910
      IF (NPRI.EQ.0) GO TO 230                                              FUTS1911
      WRITE (6,3) IO                                                        FUTS1912    425
      WRITE (6,2) (A(NN), NN = NS, NT)                                      FUTS1913    426
  230 WRITE (NOU) (A(NN), NN = NS, NT)                                      FUTS1915
C                                                                           FUTS1920    431
      IF(LASTOS) GO TO 295                                                  FUTS1925
C*** ***IF THERE ARE MORE RHS TO BE GOTTEN FROM RHS TAPE, SWITCH TAPES       FUTS1930
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      FUTSOL      - EFN   SOURCE STATEMENT  -  IFN(S)  -                          01/15/71

C*** ***BACK SO THAT  NT WILL CONTAIN THE TRAPEZOIDAL MATRIX                 FUTS1935
C*** ***NATAPE WILL HAVE NOTHING USEFUL ON IT.                               FUTS1940
      NTEMP = NATAPE                                                        FUTS1945
      NATAPE = NT                                                           FUTS1950
      NT = NTEMP                                                            FUTS1955
      REWIND NATAPE                                                         FUTS1960    443
      REWIND LTAPE                                                          FUTS1965    444
      READ  (LTAPE)   NTPJ                                                  FUTS1970    445
      GO TO 109                                                             FUTS1975
  295 REWIND LTAPE                                                          FUTS1980
C                                                                           FUTS1985
C    ***   REWIND ALL FILES EXCEPT THE OUTPUT FILE   NU                     FUTS1990
C                                                                           FUTS1995    448
      REWIND NI                                                             FUTS2000    449
      REWIND NR                                                             FUTS2005    450
      REWIND NO                                                             FUTS2010    451
      REWIND NAT                                                            FUTS2015    452
      REWIND RHSTAP                                                         FUTS2020    453
      NO = RTOTAL                                                           FUTS2025
 9999 CONTINUE                                                              FUTS2030
      RETURN                                                                FUTS2035
      END                                                                   FUTS2040
```

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      AIC         -  EFN    SOURCE STATEMENT  -  IFN(S)  -                01/15/71

      SUBROUTINE AIC(BR,S,KR,NDF,NBL,JOBNO,ICOD,VEL,NGUST,NPR2)             AICS0005
      COMMON  /NTPS/  NTP1,NTP2,NTP3,NTP4,NTP5,NTP6,NTP7,NTP8,NTP9,NTP10AICS0007
      COMPLEX  DIJMIW(400,4), CH(4,4,50), CPGUST(400), G(7)                 AICS0010
      DIMENSION  NSIZB(50,2),LIN(50,3), B(10,30)                            AICS0015
      REAL KR                                                               AICS0020
    5 FORMAT (1H1,16X,27H** AIC SUPERCOLUMNS FOR THE,I4,11H  STRIPS **//AICS0025
     1 3X,9HSTRIP NO.,3X,7HBAY NO.,3X,8HMODE NO.,9X,15HAIC SUPERCOLUMN/)AICS0030
   15 FORMAT (1H0,5X,I4,6X,I4,7X,I4,6E15.6)                                 AICS0035
   40 FORMAT (1H0, 20H  AIC IDENTIFIERS ON TAPE  9//20X, 48H JOBNO   ICOAICS0040
     10    VBW  ISORT  IROWCO     NB1    NB2/19X,2I6,F9.4,I5,  8H BAY NO.,AICS0045
     2 2I6/)                                                                AICS0050
      DO  50 I = 1,400                                                      AICS0055
   50 CPGUST(I)= (0.0,0.0)                                                  AICS0060
      DO  60 I = 1,7                                                        AICS0065
   60 G(I)      = (0.0,0.0)                                                 AICS0070
      IF (KR.LE.0.0001) KR = 1.0                                            AICS0075
      VBW = 1.0/KR                                                          AICS0080
      FACTOR    = (VBW**2)*.5*(BR**2)*.11463E-06                            AICS0085
      REWIND  NTP3                                                          AICS0090     18
      REWIND  NTP9                                                          AICS0095     19
      REWIND  NTP10                                                         AICS0100     20
      ISORT    = 1                                                          AICS0105
      READ  (NTP10) NSTRIP,NSIZB,LIN                                        AICS0110     21
      NBOX     = 0                                                          AICS0115
      DO 200   K = 1,NSTRIP                                                 AICS0120
  200 NBOX   = NBOX + LIN(K,2) - LIN(K,1) + 1                                AICS0125
      DO 540   K = 1,NSTRIP                                                 AICS0130
      DO 410  JA = 1,4                                                      AICS0135
      DO 410  IA = 1,4                                                      AICS0140
      DO 410 KA= 1,50                                                       AICS0145
  410 CH(IA,JA,KA) = (0.0,0.0)                                              AICS0150
      NDOF   = NSIZB(K,1)                                                   AICS0155
      DO 420    I = 1,NDOF                                                  AICS0160
  420 READ  (NTP3)  (DIJMIW(II,I),  II=1,NBOX)                              AICS0165     53
      IF (NGUST.NE.0.AND.K.EQ.NSTRIP) READ(NTP3) (CPGUST(I), I=1,NBOX)  AICS0170     59
      REWIND  NTP10                                                         AICS0175     65
      READ  (NTP10)                                                         AICS0180     66
      IR      = 0                                                           AICS0185
      IROWCO = LIN(K,3)                                                     AICS0190
      LING    = 0                                                           AICS0195
      DO  530  KK = 1, NSTRIP                                               AICS0200
      READ  (NTP10)  B                                                      AICS0205     72
      LIN2    = 0                                                           AICS0210
      K2      = 0                                                           AICS0215
      DO  430  L = 1, KK                                                    AICS0220
      LIN2    = LIN2  + NSIZB(L,2)                                          AICS0225
  430 CONTINUE                                                              AICS0230
      LIN1    = LIN2 - NSIZB(KK,2)                                          AICS0235
      NDOF1   = NSIZB(KK,1)                                                 AICS0240
      NDOF2   = NSIZB(KK,2)                                                 AICS0245
      DO  440  II = 1,NDOF1                                                 AICS0250
      DO  440  JJ = 1,NDOF                                                  AICS0255
      CH(II,JJ,KK) = (0.0,0.0)                                              AICS0260
      DO  440  L   = 1,NDOF2                                                AICS0265
      LA   = LIN1 + L                                                       AICS0270
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      AIC         -  EFN    SOURCE STATEMENT  -  IFN(S)  -                01/15/71

      CH(II,JJ,KK) = CH(II,JJ,KK)+B(II,L)*DIJMIW(LA,JJ)*FACTOR              AICS0275
  440 CONTINUE                                                              AICS0280
      IF (NGUST.EQ.0)  GO TO 530                                            AICS0285
      IF (K.NE.NSTRIP) GO TO 530                                            AICS0290
      DO  520  II = 1,NDOF1                                                 AICS0295
      G(II) = 0.                                                            AICS0300
      DO  520  L  = 1,NDOF2                                                 AICS0305
      LG     = LING + 1                                                     AICS0310
      G(II) = .5*.11463E-06*VEL*B(II,L)*CPGUST(LG)+G(II)                    AICS0315
  520 CONTINUE                                                              AICS0320
      LING   = LING + NDOF2                                                 AICS0325
  530 CONTINUE                                                              AICS0330
      IF (NPR2.EQ.0)  GO  TO  537                                           AICS0335
      IF (K.EQ.1) WRITE (6,5) NSTRIP                                        AICS0340     127
      DO 535 KB = 1,NSTRIP                                                  AICS0345
      DO 535 JM = 1,NDOF                                                    AICS0350
      WRITE (6,15)  K, KB, JM, (CH(JM,JMS,KB), JMS=1,NDOF1)                 AICS0355     132
  535 CONTINUE                                                              AICS0360
  537 CONTINUE                                                              AICS0365
      WRITE (NTP9)  CH                                                      AICS0370     140
  540 CONTINUE                                                              AICS0375
      RETURN                                                                AICS0380
      END                                                                   AICS0385
```

AERO - EFN SOURCE STATEMENT - IFN(S) - 01/15/71

```
      [illegible] AERO00010
      COMMON [illegible] AERO00020
      COMMON [illegible] AERO00030
      COMMON [illegible] AERO00035
      DIMENSION [illegible] AERO00040
     1 [illegible] AERO00050
      COMPLEX [illegible] AERO00060
      REAL [illegible] AERO00070
      DIMENSION [illegible] AERO00080
     1[illegible] AERO00090
      COMPLEX [illegible] AERO00100
      COMPLEX [illegible] AERO00110
      COMPLEX [illegible] AERO00120
   20 FORMAT [illegible] AERO00130
   30 FORMAT [illegible] AERO00140
   40 FORMAT [illegible] DEF-SPAN [illegible] AERO00150
     1 [illegible] AERO00160
   60 FORMAT [illegible] AERO00170
   90 FORMAT [illegible] DERIVATIVES FOR THE, I3, 7H STRIPS/[illegible] AERO00180
  100 FORMAT [illegible] AERO00190
     1 [illegible] AERO00200
     2 [illegible] AERO00210
  130 FORMAT [illegible] DERIVATIVES//) AERO00220
  140 FORMAT [illegible] DERIVATIVES/) AERO00230
  150 FORMAT [illegible] DERIVATIVES/) AERO00240
  160 FORMAT [illegible] SURFACE ROTATION/) AERO00250
  170 FORMAT [illegible] ROTATION/) AERO00260
  175 FORMAT [illegible] DERIVATIVES/) AERO00270
  180 FORMAT [illegible] DERIVATIVES/) AERO00280
  190 FORMAT [illegible] DERIVATIVES/) AERO00290
  200 FORMAT [illegible] AERO00300
     1 [illegible] AERO00310
     2 [illegible] AERO00320
  210 FORMAT [illegible] TIME-DERIVATIVE [illegible] TIME-DERIVAT AERO00330
     1 [illegible] AERO00340
  220 FORMAT [illegible] AERO00350
     1 [illegible] AERO00360
     2 [illegible] AERO00370
     3 [illegible] AERO00380
     4 [illegible] AERO00390
      S = [illegible] AERO00400
      CL      = (0.0, 0.0) AERO00410
      CY      = (0.0, 0.0) AERO00420
      CM      = (0.0, 0.0) AERO00430
      CN      = (0.0, 0.0) AERO00440
      CMDBL0 = (0.0, 0.0) AERO00450
      CMDBL0 = (0.0, 0.0) AERO00460
      CMDELT = (0.0, 0.0) AERO00470
      CMDELT = (0.0, 0.0) AERO00480
      CSL     = (0.0, 0.0) AERO00490
      DO 240 I = 1,9 AERO00500
      DO 242 J = 1,50 AERO00510
  240 [illegible] = (0.0,0.0) AERO00520
      DO 250 I=1,6 AERO00530
      DO 250 J=1,6 AERO00540
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      DO  250   K = 1,50                                    AERO00550
  250 F(I,J,K) = (0.0,0.0)                                  AERO00560
      REWIND  NTP9                                          AERO00570    24
      KRS = KR                                              AERO00580
      XG1 = FLOAT (NDELT+1)                                 AERO00590
      XG2 = FLOAT (1-NDELT)                                 AERO00600
      XL  = 2.*BR                                           AERO00610
      CMULT  = XL/ACAP                                      AERO00620
      KD  = 0./(1.11463E-06*XL*XL)                          AERO00630
      IF (KR.LT.0.0001)  KR = 1.0                           AERO00640
      XMLT = KR*KR*KD/(XL*XL)                               AERO00650
      WRITE (6,40)  KRS, KD, S, ACAP                        AERO00660    27
      ARG1= -XL/(2.0*KR)                                    AERO00670
      VBW       = 1./KR                                     AERO00680
      VBW2 = VBW*VBW                                        AERO00690
      DO 270   J = 1,6                                      AERO00700
      CAM(1,J) = (1.0,0.0)                                  AERO00710
      CAM(2,J)  = CMPLX(0.0, -VBW)                          AERO00720
  270 CAM(3,J)  = CMPLX(VBW2, 0.0)                          AERO00730
      FACTOR    = (VBW**2)*.5*(BR**2)*.11463E-06            AERO00740
      REWIND  NTP10                                         AICS0750     37
      REWIND  NTP3                                          AICS0760     38
      READ  (NTP10) NSTRIP,NSIZE,LIM,XISLCT                 AERO00770    39
      NN         = 0                                        AERO00780
      DO 280   K = 1,NSTRIP                                 AERO00790
  280 NDDE   = NDDE + LIM(K,2) - LIM(K,1) + 1               AERO00800
      NSV1 = 0                                              AERO00810
      IF (NSV.NE.0) NSV1 = NSV+1                            AERO00820
      DWD= 0.                                               AERO00830
      YR = 0.                                               AERO00840
      DO 370   K = 1,NSTRIP                                 AERO00850
      ARG1   = COS(FGAMMA(K))                               AERO00860    61
      ACG   = ABS(ARG1)                                     AERO00870
      ARG2   = SIN(FGAMMA(K))                               AERO00880    63
      FACT   = YS(K)*ARG1 + ZS(K)*ARG2                      AERO00890
      FACTY  = SQRT(YS(K)**2+ZS(K)**2)                      AERO00900    70
      ARG3   = -(BR*FACT)/(S*KR)                            AERO00910
      IF (NPC.NE.0) GO TO 320                               AERO00920
      FMV(1,K) = CMPLX(0.0,ARG1*ARG1)                       AERO00930
      DO 290   I = 2,4                                      AERO00940
      FMV(I,K) = CMPLX(ARG1,0.0)                            AERO00950
  290 CONTINUE                                              AERO00960
      DO 300   I = 5,6                                      AERO00970
      FMV(I,K) = CMPLX(ARG2,0.0)                            AERO00980
  300 CONTINUE                                              AERO00990
      FMV(7,K) = CMPLX(0.0,ARG3)                            AERO01000
  310 DELYW(K) = SQRT(DELYS(K)**2+DELZS(K)**2)              AERO01010    91
      IF (K.EQ.NSV1)  YR = 0                                AERO01020
      IF (K.EQ.NSV1)  DWD = 0.                              AERO01030
      YOS(K)     = YS(K)/S                                  AERO01040
      IF (ACG.LT.0.0001)  YOS(K) = ZS(K)/S                  AERO01050
      YR = YOS(K)                                           AERO01060
      DWD= DELYW(K)                                         AERO01070
      GO TO 370                                             AERO01080
  370 CONTINUE                                              AERO01090
      IF (NYAW.NE.0) GO TO 390                              AERO01100
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      ARG4  =  ARG1*(X1A(K) - X2A(K))                                AERO1110
      ARG5  =  ARG1*(X3A(K) - X2A(K))                                AERO1120
      DO 330  J = 1,3                                                AERO1130
  330 FHV(J,K) = CMPLX(0.0,ARG1*ARG1)                                AERO1140
      FHV(4,K) = CMPLX(ARG4,0.0)                                     AERO1150
      FHV(5,K) = (0.0,0.0)                                           AERO1160
      FHV(6,K) = CMPLX(ARG5,0.0)                                     AERO1170
      DO 340  J = 7,8                                                AERO1180
  340 FHV(J,K) = CMPLX(ARG1,0.0)                                     AERO1190
      GO TO 380                                                      AERO1200
  350 CONTINUE                                                       AERO1210
      ARG6  =  ARG2*(X1A(K) - X2A(K))                                AERO1220
      ARG7  =  ARG2*(X3A(K) - X2A(K))                                AERO1230
      DO 360  J = 1,3                                                AERO1240
  360 FHV(J,K) = CMPLX(0.0,ARG1*ARG2)                                AERO1250
      FHV(4,K) = CMPLX(ARG6,0.0)                                     AERO1260
      FHV(5,K) = (0.0,0.0)                                           AERO1270
      FHV(6,K) = CMPLX(ARG7,0.0)                                     AERO1280
      FHV(7,K) = CMPLX(0.0,ARG3)                                     AERO1290
      GO TO 380                                                      AERO1300
  370 CONTINUE                                                       AERO1310
      DO 380 K = 1,NSTRIP                                            AERO1320
      WRITE (6,30) (FHV(J,K), J = 1,7)                               AERO1330      140
  380 CONTINUE                                                       AERO1340
  400 CONTINUE                                                       AERO1350
      KB   = KRS                                                     AERO1360
      IMXS = IMX                                                     AERO1370
      DO 540  K = 1,NSTRIP                                           AERO1380
      NROF   = NSIZE(K,1)                                            AERO1390
      READ  (NTP9)  CH                                               AERO1400      162
      DO 530  KK= 1,NSTRIP                                           AERO1410
      NROF1 = NSIZE(KK,1)                                            AERO1420
      IF (NPC.NE.0) GO TO 760                                        AERO1430
      IF (NVAM.NE.0)   GO TO 472                                     AERO1440
      DO   460  IP = 1,IMX                                           AERO1450
      DO   460   J = 1,IMX                                           AERO1460
  460 F(IP,J,KK)  = F(IP,J,KK) + FHV(J,K) *CH(IP,J,KK)               AERO1470
  470 CONTINUE                                                       AERO1480
      GO TO   510                                                    AERO1490
  472 CONTINUE                                                       AERO1500
      JZ = 0                                                         AERO1510
      DO 490  IP = 5,6                                               AERO1520
      JZ = JZ + 1                                                    AERO1530
      DO 480    J = 1,4                                              AERO1540
  480 F(J,JZ,KK) = F(J,JZ,KK)+FHV(IP,K)*CH(J,JZ,KK)                  AERO1550
  490 CONTINUE                                                       AERO1560
      DO 500    J = 1,4                                              AERO1570
  500 F(J, 3,KK) = F(J, 3,KK)+FHV( 7,K)*CH(J, 1,KK)                  AERO1580
      GO TO 510                                                      AERO1590
  760 CONTINUE                                                       AERO1600
      IF (NVAM.NE.0) GO TO 810                                       AERO1610
  770 DO 800  IP = 1,IMX                                             AERO1620
      DO 780  J = 1,3                                                AERO1630
      JP = J + 3                                                     AERO1640
      F(IP,1,KK) = F(IP,1,KK)+CH(IP,J,KK)*FHV(J, K)                  AERO1650
      F(IP,2,KK) = F(IP,2,KK)+CH(IP,J,KK)*FHV(JP,K)                  AERO1660
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AERO        - EFN   SOURCE STATEMENT  -  IFN(S)  -                    01/15/71

  780 CONTINUE                                                       AERO1670
      IF (IMX.LE.3) GO TO 790                                        AERO1680
      F(IP,3,KK) = F(IP,3,KK)+CH(IP,4,KK)*FHV(7,K)                   AERO1690
  790 CONTINUE                                                       AERO1700
  800 CONTINUE                                                       AERO1710
      GO TO  510                                                     AERO1720
  810 CONTINUE                                                       AERO1730
      DO 830 IJ = 1,3                                                AERO1740
      DO 820  J = 1,3                                                AERO1750
      JA = J + 3                                                     AERO1760
      F(IJ,1,KK) = F(IJ,1,KK)+CH(IJ,J,KK)*FHV(J, K)                  AERO1770
      F(IJ,2,KK) = F(IJ,2,KK)+CH(IJ,J,KK)*FHV(JA,K)                  AERO1780
      F(IJ,3,KK) = F(IJ,3,KK)+CH(IJ,J,KK)*FHV(7, K)                  AERO1790
  820 CONTINUE                                                       AERO1800
  830 CONTINUE                                                       AERO1810
  510 CONTINUE                                                       AERO1820
  530 CONTINUE                                                       AERO1830
  540 CONTINUE                                                       AERO1840
      IMXX = IMX                                                     AERO1850
      IF (NVAM.NE.0)  IMXX=3                                         AERO1860
      JV1= 1                                                         AERO1870
      JV2 = IMXS                                                     AERO1880
      DO 580   KV  = 1,NSTRIP                                        AERO1890
      DO 570   JV = JV1,JV2                                          AERO1900
      DO 550   IV = 1,IMXX                                           AERO1910
  550 F(IV,JV,KV)    =(F(IV,JV,KV)/DELY*(KV))*XMLT                   AERO1920
      IF (NPC.EQ.0) GO TO 560                                        AERO1930
      FS1 = F(1,JV,KV)                                               AERO1940
      FS3 = F(3,JV,KV)                                               AERO1950
      F(1,JV,KV) = F(1,JV,KV)+F(2,JV,KV)+F(3,JV,KV)                  AERO1960
      F(2,JV,KV) = FS1*(X1A(KV)-X2A(KV))+FS3*(X3A(KV)-X2A(KV))       AERO1970
      F(3,JV,KV) = F(4,JV,KV)                                        AERO1980
  560 F(1,JV,KV) = F(1,JV,KV)*XL                                     AERO1990
  570 CONTINUE                                                       AERO2000
  580 CONTINUE                                                       AERO2010
      WRITE (6,90)  NSTRIP                                           AERO2020      318
      M1 = 1                                                         AERO2030
      M2 = IMXS                                                      AERO2040
      IF (NVAM.NE.0)  M1 = 5                                         AERO2050
      IF (NVAM.NE.C)  M2 = 7                                         AERO2060
      IF (NVAM.NE.0.AND.IMXS.NE.IMX) M2=8                            AERO2070
      MI = 0                                                         AERO2080
      DO 65C  MIX = M1,M2                                            AERO2090
      SUMM =(0.0,0.0)                                                AERO2100
      SUMV =(0.0,C.0)                                                AERO2110
      SUM  =(0.0,0.0)                                                AERO2120
      SUMMR=(0.0,0.0)                                                AERO2130
      SUMVR=(0.0,0.0)                                                AERO2140
      SUMM =(0.0,0.0)                                                AERO2150
      GO TO (670,68C,690,700,710,730,720,650), MIX                   AERO2160
  590 WRITE (6,100)                                                  AERO2170      324
      MI = MI+1                                                      AERO2180
      DO 630   KX  = 1,NSTRIP                                        AERO2190
      WRITE (6,80) KX,YOS(KX),F(1,MI,KX),F(2,MI,KX),F(3,MI,KX),F(4,MI,KXAERO2200
     1)                                                              AERO2210      327
  600 CONTINUE                                                       AERO2220
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      AERO        - EFN    SOURCE STATEMENT  -  IFN(S)  -                  01/15/71

      CL     = CL     + F(1,MI,KK)*DELYS(KK)                            AERO2230
      CY     = CY     + F(1,MI,KK)*DELZS(KK)                            AERO2240
      CM     = CM     + (F(2,MI,KK)+(XLA(KK)/XL)*F(1,MI,KK))*DELYS(KK)  AERO225C
      CN     = CN     + (F(2,MI,KK)+(XLA(KK)/XL)*F(1,MI,KK))*DELZS(KK)  AERO2260
      CMDELA = CMDELA + (F(3,MI,KK)+(XSA(KK)/XL)*F(1,MI,KK))*DELYS(KK)  AERO2270
      CNDELA = CNDELA + (F(3,MI,KK)+(XSA(KK)/XL)*F(1,MI,KK))*DELZS(KK)  AERO2280
      CMDELT = CMDELT + (F(4,MI,KK)+(XSA(KK)/XL)*F(1,MI,KK))*DELYS(KK)  AERO2290
      CNDELT = CNDELT + (F(4,MI,KK)+(XSA(KK)/XL)*F(1,MI,KK))*DELZS(KK)  AERO2300
      CSL    = CSL    + F(1,MI,KK)*(DELYS(KK)*YS(KK)+DELZS(KK)*ZS(KK))/SAERO2310
      IF (KK.GT.NSV)  GO TO 610                                         AERO2320
      SUMV  = SUMV  + F(1,MI,KK)*DELZS(KK)                              AERO2330
      SUMVM = SUMVM + F(2,MI,KK)*DELZS(KK)                              AERO2340
      GO TO    620                                                      AERO2350
  610 SUMH  = SUMH  + F(1,MI,KK)*DELYS(KK)                              AERO2360
      SUMHM = SUMHM + F(2,MI,KK)*DELYS(KK)                              AERO2370
  620 CONTINUE                                                          AERO2380
  630 CONTINUE                                                          AERO2390
      CL     = CMULT * CL      * XG1                                    AERO2400
      CY     = CMULT * CY      * XG2                                    AERO2410
      CM     = CMULT * CM      * XG1                                    AERO2420
      CN     = CMULT * CN      * XG2                                    AERO2430
      CMDELA = CMULT * CMDELA  * XG1                                    AERO2440
      CNDELA = CMULT * CNDELA  * XG2                                    AERO2450
      CMDELT = CMULT * CMDELT  * XG1                                    AERO2460
      CNDELT = CMULT * CNDELT  * XG2                                    AERO2470
      CSL    =(CMULT * CSL/2.0)* XG2                                    AERO2480
      WRITE (6,200) CL,CY,CM,CN,CMDELA,CNDELA,CMDELT,CNDELT,CSL         AERO2490    383
      SUM  = SUMH - 2.*SUMV                                             AERO2500
      SUMM = SUMHM- 2.*SUMVM                                            AERO2510
      IF (NPASS.NE.1) GO TO 640                                         AERO2520
      LX = 2                                                            AERO2530
      IF (ABS.LT.0.0001)  LX = 1                                        AERO2540
      CLA(LX,MI)=REAL(CAM(LX,MI))* CL)                                  AERO2550
      CMA(LX,MI)=REAL(CAM(LX,MI))* CM)                                  AERO2560
      CMDAA(LX,MI)=REAL(CAM(LX,MI))*CMDELA)                             AERO2570
      CMDTA(LX,MI) =REAL(CAM(LX,MI))*CMDELT)                            AERO2580
      CSLA(LX,MI)=REAL(CAM(LX,MI))*CSL)                                 AERO2590
      IF (MOP.EQ.1)   GO TO 640                                         AERO2600
      IF (LX.EQ.1)   GO TO 640                                          AERO2610
      READ (2)   (CLA(1,MI),   MI=1,6)                                  AERO2620    405
      READ (2)   (CMA(1,MI),   MI=1,6)                                  AERO2630    410
      READ (2)   (CMDAA(1,MI),MI=1,6)                                   AERO2640    415
      READ (2)   (CMDTA(1,MI),MI=1,6)                                   AERO2650    420
      READ (2)   (CSLA(1,MI), MI=1,6)                                   AERO2660    425
      CLA(3,MI) =REAL(CAM(3,MI))* (CLA(1,MI) -REAL(CL))                 AERO2670
      CMA(3,MI) =REAL(CAM(3,MI))* (CMA(1,MI) -REAL(CM))                 AERO2680
      CMDAA(3,MI)=REAL(CAM(3,MI))*(CMDAA(1,MI) -REAL(CMDELA))           AERO2690
      CMDTA(3,MI)=REAL(CAM(3,MI))*(CMDTA(1,MI) -REAL(CMDELT))           AERO2700
      CSLA(3,MI) =REAL(CAM(3,MI))*(CSLA(1,MI)  -REAL(CSL))              AERO2710
      WRITE   (6,210)                                                   AERO2720    445
      IF (MI.EQ.1)   GO TO 790                                          AERO2730
      IF (MI.EQ.5.OR.MI.EQ.6)   GO TO 790                               AERO2740
      WRITE (6,220) CLA(1,MI),CLA(2,MI),CLA(3,MI),CMA(1,MI),CMA(2,MI),  AERO2750
     1 CMA(3,MI),CMDAA(1,MI),CMDAA(2,MI),CMDAA(3,MI),CMDTA(1,MI),CMDTA(AERO2760
     22,MI),CMDTA(3,MI),CSLA(1,MI),CSLA(2,MI),CSLA(3,MI),CSYA(1,MI),CSYAAERO2770
     3(2,MI),CSYA(3,MI)                                                 AERO2780    451
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      AERO        - EFN    SOURCE STATEMENT  -  IFN(S)  -                  01/15/71

  640 CONTINUE                                                          AERO2790
      CL     = (0.0,0.0)                                                AERO2800
      CY     = (0.0,0.0)                                                AERO2810
      CM     = (0.0,0.0)                                                AERO2820
      CN     = (0.0,0.0)                                                AERO2830
      CMDELA = (0.0,0.0)                                                AERO2840
      CNDELA = (0.0,0.0)                                                AERO2850
      CMDELT = (0.0,0.0)                                                AERO2860
      CNDELT = (0.0,0.0)                                                AERO2870
      CSL    = (0.0,0.0)                                                AERO2880
  650 CONTINUE                                                          AERO2890
      GO  TO  840                                                       AERO2900
  660 CONTINUE                                                          AERO2910
      WRITE (2) (CLA(1,MI),   MI=1,6)                                   AERO2920    475
      WRITE (2) (CMA(1,MI),   MI=1,6)                                   AERO2930    482
      WRITE (2) (CMDAA(1,MI),MI=1,6)                                    AERO2940    489
      WRITE (2) (CMDTA(1,MI),MI=1,6)                                    AERO2950    496
      WRITE (2) (CSLA(1,MI), MI=1,6)                                    AERO2960    503
      GO TO  640                                                        AERO2970
  670 WRITE (6,120)                                                     AERO2980    511
      GO TO  590                                                        AERO2990
  680 WRITE (6,130)                                                     AERO3000    513
      GO TO  590                                                        AERO3010
  690 WRITE (6,140)                                                     AERO3020    515
      GO TO  590                                                        AERO3030
  700 WRITE (6,150)                                                     AERO3040    517
      GO TO  590                                                        AERO3050
  710 WRITE (6,190)                                                     AERO3060    519
      GO TO 590                                                         AERO307C
  720 WRITE (6,170)                                                     AERO3080    521
      GO TO  590                                                        AERO3090
  730 WRITE (6,180)                                                     AERO3100    523
      GO TO  590                                                        AERO3110
  750 CONTINUE                                                          AERO3120
      CLA(4,MI)     = AIMAG(CL)                                         AERO3130
      CMA(4,MI)     = AIMAG(CM)                                         AERO3140
      CMDAA(4,MI)   = AIMAG(CMDELA)                                     AERO3150
      CMDTA(4,MI)   = AIMAG(CMDELT)                                     AERO3160
      CSLA(4,MI)    = AIMAG(CSL)                                        AERO3170
      WRITE (6,220) CLA(1,MI),CLA(4,MI),CLA(2,MI),CMA(1,MI),CMA(4,MI),  AERO3180
     1  CMA(2,MI),CMDAA(1,MI),CMDAA(4,MI),CMDAA(2,MI),CMDTA(1,MI),CMDTA(AERO3190
     24,MI),CMDTA(2,MI),CSLA(1,MI),CSLA(4,MI),CSLA(2,MI),CSYA(1,MI ,CSYAAERO3200
     3(4,MI),CSYA(2,MI)                                                 AERO3210    531
      GO TO 640                                                         AERO3220
  840 CONTINUE                                                          AERO3230
      RETURN                                                            AERO3240
      END                                                               AERO3250
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      FINAL        - EFN   SOURCE STATEMENT  -  IFN(S)  -              01/15/71

      SUBROUTINE FINAL(DP,BI,ACAP,NSV,NBV,INX,NYAW,NPC,NDELT,FGAMMA)     FINA0010
      COMMON  /XKZ/  XOC(400),(IJ(50)                                    CXSS0020
      COMMON /VZV/    X1A(50), X3A(50), X5A(50),X7A(50),X2A(50)          FINA0050
      COMMON  /NTPS/  NTP1,NTP2,NTP3,NTP4,NTP5,NTP6,NTP7,NTP8,NTP9,NTP10FINA0060
      DIMENSION  FGAMMA(50)                                              CXSS0070
      REAL  KR                                                           FINA0080
      COMPLEX CPM(400,4),CPS(400,4)                                      CXSS0090
      DIMENSION  NSIZB(50,2), LIN(50,3)                                  FINA0100
   20 FORMAT (1H0,10X,8E16.8)                                            FINA0130
   40 FORMAT (1H1,30X,34HPRESSURE COEFFICIENTS FOR MODE NC..I4//)        FINA0140
   60 FORMAT (1H0,20X,14HSTRIP NO.  XOC,25X, 7HC-SUB-P/)                 FINA0160
   80 FORMAT (1H0,22X,I3,F11.4,18X,2F15.8)                               FINA0180
      REWIND  NTP3                                                       FINA0300      1
      REWIND  NTP10                                                      FINA0310      2
      EPSI   = 0.00001                                                   FINA0320
      PI     = 3.141593                                                  FINA0330
      DO 190  J = 1,4                                                    FINA0340
      DO 190  I = 1,400                                                  FINA0350
      CPM(I,J) = (0.,0.)                                                 FINA0360
  190 CPS(I,J) = (0.,0.)                                                 FINA0370
      READ (10)NSTRIP,NSIZB,LIN                                          FINA0380     13
      NBOX = 0                                                           FINA0390
      DO 200  K = 1, NSTRIP                                              FINA0400
  200 NBOX = NBOX + LIN(K,2)-LIN(K,1) + 1                                FINA0410
      J1 = 1                                                             FINA0420
      NDOF = NSIZB(1,1)                                                  FINA0430
      XGAM = COS(FGAMMA(1))                                              FINA0440     29
      IF (NYAW .NE.0) XGAM = SIN(FGAMMA(1))                              FINA0450     31
      DO 240  J = J1, NDOF                                               FINA0460
      READ  (NTP3)  (CPM(IX,J),  IX=1,NBOX)                              FINA0470     35
      IF  (NBV.NE.0.AND.NDELT.NE.0) GO TO 210                            FINA0480
      GO TO  230                                                         FINA0490
  210 DO 220  IL = 1,NBV                                                 FINA0500
  220 CPM(IL,J)  = 2.0*CPM(IL,J)                                         FINA0510
  230 CONTINUE                                                           FINA0520
      DO 240  I = 1,NBOX                                                 FINA0530
  240 CPS(I,J) = CPM(I,J)*XGAM                                           FINA0540
  295 CONTINUE                                                           FINA0670
      NS = NSTRIP - 1                                                    FINA0680
      DO  400   K = 1, NS                                                FINA0690
      K1= K+1                                                            FINA0700
      NDOF = NSIZB(K1,1)                                                 FINA0710
      XGAM = COS(FGAMMA(K1))                                             FINA0720     68
      IF (NYAW .NE.0) XGAM = SIN(FGAMMA(K1))                             FINA0730     71
      DO 330   JX = J1,NDOF                                              FINA0740
      READ  (NTP3)  (CPM(II,JX),  II=1,NBOX)                             FINA0750     75
      IF  (NBV.NE.0.AND.NDELT.NE.0) GO TO 300                            FINA0760
      GO TO  320                                                         FINA0770
  300 DO 310  JL = 1,NBV                                                 FINA0780
  310 CPM(JL,JX) = 2.0*CPM(JL,JX)                                        FINA0790
  320 CONTINUE                                                           FINA0800
  330 CONTINUE                                                           FINA0810
      DO 340  JY = 1,NDOF                                                FINA0820
      DO 340  IY = 1,NBOX                                                FINA0830
  340 CPS(IY,JY) = CPS(IY,JY) + CPM(IY,JY)*XGAM                          FINA0840
```

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      FINAL        - EFN   SOURCE STATEMENT  -  IFN(S)  -              01/15/71

  400 CONTINUE                                                           FINA0903
  430 DO 510 KK = 1,INX                                                  FINA1040
      WRITE  (6,40)  KK                                                  FINA1050    110
      WRITE (6,60)                                                       FINA1060    111
      DO 500   JZ = 1,NSTRIP                                             FINA1070
      I1   = LIN(JZ,1)                                                   FINA1080
      I2   = LIN(JZ,2)                                                   FINA1090
      DO 490   IV = I1,I2                                                FINA1100
      WRITE (6,80) JZ,XOC(IV),CPS(IV,KK)                                 FINA1110    119
  490 CONTINUE                                                           FINA1120
  500 CONTINUE                                                           FINA1130
  510 CONTINUE                                                           FINA1140
  700 RETURN                                                             FINA1240
      END                                                                FINA1250
```

```
      SUBROUTINE GENF(NDELT,NB,NSTRIP,NBOX,NTOT,NBV,NSV,NMO,LIM,ACAP,FL,GENF0010
     1               B2,EV,Y,ZZ,SDELX,XIJ,XOC,X)                        GENF0020
      COMMON  /BODY/ RO( 80),ROP( 80),NBEA(20),BGMA(20),MRK(20,2)      GENF0030
      COMMON  /NTPS/  NTP1,NTP2,NTP3,NTP4,NTP5,NTP6,NTP7,NTP8,NTP9,NTP10GENF0040
      DIMENSION  LIM(50,3), XIJ(50),YOS(50),EV(400),SDELX(400)        GENF0050
      DIMENSION  BF(400), B(50), Y(400), ZZ(400),   XOC(400),X(400)   GENF0060
      DIMENSION  XBLE(20), CBODY(20)                                   GENF0070
      COMPLEX   GF(400), GFT                                           GENF0080
      COMPLEX  P(400), CLJ(50), CMJ(50)                                GENF0090
      COMPLEX  CZ,CY,CR,CM,CLI,PRT1,PRT2,PRT3,PRT4                     GENF0100
      COMPLEX     CZB,CYB,CMB,CNB,CLIB                                 GENF0110
      COMPLEX     PRES,CLJKK,CMJKK                                     GENF0120
      COMMON /XYZ/YS(50),DELYS(50),ZS(50),DELZS(50),FGAMMA(50),CWIG(50) GENF0130
    5 FORMAT  (1H0,5X,6E20.8)                                          GENF0140
   10 FORMAT  (1H1,40X, 7HMODE NO.I4//10X, 9HSTRIP NO.,5X,1HY,12X,1HZ,  GENF0150
     112X, 3HYOS,10X,16HLIFT COEFFICIENT,18X,18HMOMENT COEFFICIENT/)   GENF0160
   12 FORMAT  (1H0,40X, 7HMODE NO.I4//10X, 9HBODY  NO.,5X,1HY,12X,1HZ,  GENF0162
     112X, 3HYOS,10X,16HLIFT COEFFICIENT,18X,18HMOMENT COEFFICIENT/)   GENF0164
   20 FORMAT  (1H0,13X,I4, 3F12.4, 2F16.5,5X, 2F16.6)                  GENF0170
   30 FORMAT  (1H0,3X//15X, 4HCZ =,2F16.6,10X,4HCY =,2F16.6/15X, 4HCM =,GENF0180
     1          2F16.6,10X,4HCN =,2F16.6/15X,10HCL(ROLL) =,2F16.6/)    GENF0190
   32 FORMAT (1H1,40X, 7HMODE NO.  I4//                                GENF0200
     1              5X, 9HBOX NO.  ,3X, 3HXOC,5X,2H X,7X,2HY ,7X,2HZ ,15X,GENF0210
     2 9HPRESSURES//)                                                  GENF0220
   34 FORMAT  (1H0,3X//15X,13HPRESSURE MODE,5X,15HDEFLECTION MODE,10X,  GENF0230
     1        18HGENERALIZED FORCES/)                                  GENF0240
   36 FORMAT  (1H0,20X,I4,16X,I4,5X,2E18.8)                            GENF0250
   40 FORMAT (1H0, 5X,I3,F10.5,3F11.5,2E18.8)                          GENF0260
      REWIND  NTP3                                                     GENF0270    1
      REWIND  NTP7                                                     GENF0280    2
      REWIND  NTP10                                                    GENF0290    3
      DO 50  I=1,50                                                    GENF0300
      CLJ(I) = (0.0,0.0)                                               GENF0310
      CMJ(I) = (0.0,0.0)                                               GENF0320
   50 CONTINUE                                                         GENF0330
      XA    = FLOAT(1+NDELT) /(     ACAP)                              GENF0340
      XB    = -XA/FL                                                   GENF0350
      XC    = -FLOAT(1-NDELT)/(     ACAP*B2)                           GENF0360
      IP1   = NBOX+1                                                   GENF0370
      DO  60  L=1,20                                                   GENF0380
      XBLE(L) = 0.0                                                    GENF0390
      CBODY(L)= 0.0                                                    GENF0400
   60 CONTINUE                                                         GENF0410
      IBX1 = NBOX                                                      GENF0420
      I2    = IBX1                                                     GENF0430
      IF (NB.EQ.0)  GO TO 90                                           GENF0435
      DO  80  L=1,NB                                                   GENF0440
      I1    = I2+1                                                     GENF0450
      I2    = IBX1+NBEA(L)                                             GENF0460
      XBLE(L)   = X(I1)-SDELX(I1)/2.0                                  GENF0470
      DO  70  I=I1,I2                                                  GENF0480
      CBODY(L) = CBODY(L)+SDELX(I)                                     GENF0490
   70 CONTINUE                                                         GENF0500
   80 CONTINUE                                                         GENF0510
   90 CONTINUE                                                         GENF0515
      DO 300 J=1,NMO                                                   GENF0520
      CZ    = (0.0,0.0)                                                GENF0530
```



```
      CY    = (0.0,0.0)                                                GENF0540
      CM    = (0.0,0.0)                                                GENF0550
      CN    = (0.0,0.0)                                                GENF0560
      CLI   = (0.0,0.0)                                                GENF0570
      READ  (NTP3)   (P(I),  I = 1, NBOX)                              GENF0580   45
      IF (NBOX.EQ.NTOT)  GO TO 100                                     GENF0590
      READ  (NTP7 )  (P(IP), IP=IP1,NTOT)                              GENF0600   52
  100 CONTINUE                                                         GENF0610
      DO 200 K=1,NSTRIP                                                GENF0620
      CLJ(K) = (0.0,0.0)                                               GENF0630
      CMJ(K) = (0.0,0.0)                                               GENF0640
      SIGN1= 1.0                                                       GENF0650
      SIGN2= 1.0                                                       GENF0660
      CGAM = COS(FGAMMA(K))                                            GENF0670   63
      SGAM = SIN(FGAMMA(K))                                            GENF0680   65
      IF (CGAM.LT.0.0)  SIGN1=-1.0                                     GENF0690
      IF (SGAM.LT.0.0)  SIGN2=-1.0                                     GENF0700
      I1    = LIM(K,1)                                                 GENF0710
      I2    = LIM(K,2)                                                 GENF0720
      DO 150 I=I1,I2                                                   GENF0730
      PRT1 = P(I)*SDELX(I)                                             GENF0740
      CLJ(K) = CLJ(K) + PRT1/CWIG(K)                                   GENF0750
      CMJ(K) = CMJ(K) + PRT1*(EV(I)-XIJ(K))/(CWIG(K)**2)               GENF0760
  150 CONTINUE                                                         GENF0770
      PRT2 = CLJ(K)*CWIG(K)                                            GENF0780
      CZ    = CZ + PRT2*DELYS(K)*SIGN1                                 GENF0790
      CY    = CY + PRT2*DELZS(K)*SIGN2                                 GENF0800
      PRT3 =-CMJ(K)*(CWIG(K)**2)                                       GENF0810
      PRT4 = CLJ(K)* CWIG(K)*XIJ(K)                                    GENF0820
      CM    = CM + (PRT3+PRT4)*DELYS(K)*SIGN1                          GENF0830
      CN    = CN + (PRT3+PRT4)*DELZS(K)*SIGN2                          GENF0840
      FACT = YS(K)*DELYS(K)*SIGN1 + ZS(K)*DELZS(K)*SIGN2               GENF0850
      CLI   = CLI+ CLJ(K)*CWIG(K)*FACT                                 GENF0860
  200 CONTINUE                                                         GENF0870
      WRITE (6,32)  J                                                  GENF0880  108
      DO 235  I=1,NBOX                                                 GENF0890
      PRES = P(I)                                                      GENF0900
      IF (NBV.NE.0.AND.I.LE.NBV)  PRES=2.0*P(I)                        GENF0910
      WRITE (6,40) I,XOC(I),EV(I),Y(I),ZZ(I), PRES                     GENF0920  114
  235 CONTINUE                                                         GENF0930
      CZB   = (0.0,0.0)                                                GENF0940
      CYB   = (0.0,0.0)                                                GENF0950
      CMB   = (0.0,0.0)                                                GENF0960
      CNB   = (0.0,0.0)                                                GENF0970
      CLIB = (0.0,0.0)                                                 GENF0980
      IF (NB.EQ.0)  GO TO  245                                         GENF0985
      I2    = IBX1                                                     GENF0990
      L1    = NSTRIP+1                                                 GENF1000
      L2    = NSTRIP+NB                                                GENF1010
      LL    = 0                                                        GENF1020
      KB    = 0                                                        GENF1030
      DO 240  LB=L1,L2                                                 GENF1040
      CLJ(LB) = (0.0,0.0)                                              GENF1050
      CMJ(LB) = (0.0,0.0)                                              GENF1060
      LL    = LL+1                                                     GENF1070
      I1    = I2+1                                                     GENF1080
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      GENF        - EFN   SOURCE STATEMENT  -  IFN(S)  -                 01/15/71

      IZ    = IBX1+NBEA(LL)                                              GENF1090
      YSB   = Y(I1)                                                      GENF1100
      ZSB   =ZZ(I1)                                                      GENF1110
      XMULT= 1.0                                                         GENF1120
      IF (ABS(YSB).LE.0.0001)  XMULT=0.5                                 GENF1130
      DO 232  I=I1,I2                                                    GENF1140
      KB    = KB+1                                                       GENF1150
      CFAC = 2.0*RO(KB)*SDELX(I) /(CBODY(LL)**2)                         GENF1160
      CLJ(LB) = CLJ(LB)+P(I)*CFAC                                        GENF1170
      CMJ(LB) = CMJ(LB)-P(I)*CFAC*(X(I)-XBLE(LL))/CBODY(LL)              GENF1180
  238 CONTINUE                                                           GENF1190
      DYB   = CBODY(LL)                                                  GENF1200
      IF (BGMA(LL).LT.0.0)  DYB=0.0                                      GENF1210
      DZB   = 0.0                                                        GENF1220
      IF (BGMA(LL).LT.0.0)  DZB=CBODY(LL)                                GENF1230
      PRT2 = CLJ(LB)*CBODY(LL)                                           GENF1240
      CZB   = CZG + PRT2*DYB*XMULT                                       GENF1250
      CYB   = CYB + PRT2*DZB*XMULT                                       GENF1260
      PRT3 =-CMJ(LB)*CBODY(LL)**2                                        GENF1270
      PRT4 = CLJ(LB)*CBODY(LL)*XBLE(LL)                                  GENF1280
      CMB   = CMB + (PRT3+PRT4)*DYB*XMULT                                GENF1290
      CMB   = CNB + (PRT3+PRT4)*DZB*XMULT                                GENF1300
      FACT = YSB*DYB + ZSB*DZB                                           GENF1310
      CLIB = CLIB + CLJ(LB)*CBODY(LL)*FACT                               GENF1320
  240 CONTINUE                                                           GENF1330
  245 CONTINUE                                                           GENF1335
      CZ    = CZ + CZB                                                   GENF1340
      CY    = CY + CYB                                                   GENF1350
      CM    = CM + CMB                                                   GENF1360
      CN    = CN + CNB                                                   GENF1370
      CLI   = CLI+ CLIB                                                  GENF1380
      CZ    = XA*CZ                                                      GENF1390
      CY    =-XA*CY                                                      GENF1400
      CM    = XB*CM                                                      GENF1410
      CN    = XC*CN                                                      GENF1420
      CLI   =-XC*CLI                                                     GENF1430
      WRITE (6,10)  J                                                    GENF1440     180
      DO 250 K=1,NSTRIP                                                  GENF1450
      YOS(K) = YS(K)/B2                                                  GENF1460
      CLJXK= CLJ(K)                                                      GENF1470
      CMJXK= CMJ(K)                                                      GENF1480
      IF (NSV.NE.0.AND.K.LE.NSV)  CLJXK=2.0*CLJXK                        GENF1490
      IF (NSV.NE.0.AND.K.LE.NSV)  CMJXK=2.0*CMJXK                        GENF1500
      WRITE (6,20) K,YS(K),ZS(K),YOS(K), CLJXK , CMJXK                   GENF1510     190
  250 CONTINUE                                                           GENF1520
      IF (NB.EQ.0)  GO TO  265                                           GENF1525
      KL    = J                                                          GENF1530
      WRITE (6,12) J                                                     GENF1535     199
      DO 260  L=L1,L2                                                    GENF1540
      KL    = KL+1                                                       GENF1550
      IL    = NBOX + NBEA(KL)                                            GENF1560
      YSB   = Y(IL)                                                      GENF1570
      ZSB   =ZZ(IL)                                                      GENF1580
      YBOS = YSB/B2                                                      GENF1590
      WRITE (6,20)  KL,YSB,ZSB,YBOS,CLJ(L),CMJ(L)                        GENF1600     207
  260 CONTINUE                                                           GENF1610
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      GENF        - EFN   SOURCE STATEMENT  -  IFN(S)  -                 01/15/71

  265 CONTINUE                                                           GENF1615
      WRITE (6,30) CZ, CY, CM, CN, CLI                                   GENF1620     212
      REWIND  NTP10                                                      GENF1630     213
      WRITE (6,34)                                                       GENF1640     214
      DO 275  JG=1,NMC                                                   GENF1650
      READ  (NTP10)  (BF(IB),  IB=1,NTOT)                                GENF1660     216
      GFT   =(0.0,0.0)                                                   GENF1670
      DO 272  IX=1,NTOT                                                  GENF1680
      GF(IX)=     P(IX)*BF(IX                                            GENF1690
      GFT   = GFT + GF(IX)                                               GENF1700
  272 CONTINUE                                                           GENF1710
      WRITE (6,36)  J, JG, GFT                                           GENF1720     220
  275 CONTINUE                                                           GENF1730
  300 CONTINUE                                                           GENF1740
      RETURN                                                             GENF1750
      END                                                                GENF1760
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13. ABSTRACT

Two methods of accounting for body-lifting surface interference in unsteady flow are considered. The first method is described in Part I of this report, while the second will be described in Part II to follow.

The first method is a direct application of nonplanar lifting surface elements to both the lifting surfaces and the body surfaces. The body is treated as an annular wing. This type of idealization must be used with an axial doublet introduced to account for body incidence effects. The undesirable effects of the annular wing representation are then reduced.

The second approach, to be described in Part II, uses an image system and an axial singularity system to account for the effects of the bodies.

This report also describes an improvement of the Doublet-Lattice Method of Albano and Rodden. The improvement pertains to wing-tail problems where there exists a small vertical (non-zero) separation between the wing and tail planes. Such problems can now be handled with ease.

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